With warmest regards

from Yours Sincerely

Albert B. Bach

THE

PRINCIPLES OF SINGING

Only that method is correct which renders singing gradually more and more easy, and makes it a pleasure both to the singer and to those listening to him.

Albert B. Bach.

FROM A PHOTOGRAPH BY CROOKE, EDINBURGH.

THE

PRINCIPLES OF SINGING

A PRACTICAL GUIDE FOR VOCALISTS AND TEACHERS

WITH VOCAL EXERCISES

BY

ALBERT B. BACH

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'THE ART BALLAD: LOEWE AND SCHUBERT, WITH MUSICAL ILLUSTRATIONS,' ETC.

OHIO STATE UNIVERSITY

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TO

HIS EXCELLENCY

BARON FRIEDRICH PODMANICZKY,

INTENDANT OF THE ROYAL OPERA AND HUNGARIAN NATIONAL THEATRE IN BUDAPEST.

DEAR BARON,—The great esteem and reverence I feel for you, I wish to express in dedicating this work to you.

I cannot without gratitude remember the occasions during which I had the honour of singing in your theatre, when you demonstrated so much sympathy and interest for each of the parts which I represented in the summer seasons of 1878 and 1885.

Your kind approbation, and the flattering reception by the audience, render the evenings I have passed at your beautiful theatre an enduringly dear recollection to me; and considering the great interest you take in the efforts of the artists whose services you enlist, it would give me a particular pleasure and satisfaction to know that this book will not remain unused in your library.—Believe me, dear Baron, your most obedient,

ALBERT B. BACH.

13 CASTLE TERRACE,
EDINBURGH, *October* 1885.

PREFACE TO THE SECOND EDITION.

THE recognition extended to this book, since its first publication, by all interested in vocal art, has been a very gratifying reward of my labours. The results which have been attained by imparting my method to numerous pupils, endowed with different voices and of varying abilities, have been such as to convince me of the soundness and practical value of the views therein expressed. No alterations, therefore, have been deemed necessary in preparing this new edition. My endeavour in the volume has been to embody everything of importance handed down to us from the celebrated schools of Pistocchi and Bernacchi, together with the teaching of the more modern schools of Ronconi, Lamperti, and Varesi, while bringing both into correspondence with Helmholtz's vowel theory and the discoveries of recent physiology. In addition, I would recommend teachers and students alike not to be satisfied with the production of a pleasant or powerful tone, but to devote attention also to the cultivation of taste and intelligence. To the vocalist

of modern times, wide literary and artistic culture is above all necessary: his imaginative faculties must be stimulated by the study of poetry and history, and his mind induced to attain the loftiness of aim required for the expression of grand dramatic emotion, if he would truly impersonate the characters he has to represent. The old Italian school directed its attention chiefly to the cultivation of the sensuous beauty and instrumental capacity of the voice. Modern music, with its manifold modulations and its wealth of tone colour, makes higher demands on the vocalist, requiring an increased study of the dramatic significance of the music and the proper expression of the words. Through higher education and greater knowledge of music, the taste and claims of the public have changed in a like manner. To attain success, accordingly, the singer must acquire a virtuosity in tone colour hardly known in former days, but now becoming a prime requisite for a dramatic artist.

Formerly, technical flexibility was the object of unremitting effort; nowadays, the first place must be given to what may be called intellectual flexibility—that is, the capacity to express all shades of feeling and meaning. A good example of these increased modern requirements may be found in Weber's "Euryanthe," that masterpiece of the illustrious founder of romantic opera. The great dramatic air sung by Lysiart, the rejected and unhappy lover of Euryanthe, affords the vocalist ample opportunity for the display of his skill

in combining the two methods of singing. The powerful recitative with which it opens demands distinct pronunciation, dramatic expression, and declamatory emphasis; the lyrical passages following call for a beautiful cantilena; while the runs in the allegro and the accents of rage and grief in the finale cannot be executed without great flexibility, well developed breathing, and admirable power of expression. The same may be said of most of Wagner's dramatic music and of Loewe's dramatic ballads.[1]

For vocalists endowed with ordinary voices, of limited compass to attempt difficult operatic airs is a serious mistake. Leaving these to artists gifted by nature with great vocal powers and dramatic talent, and dismissing those dreams of figuring on the stage so often vainly cherished, they should rather turn their ambition to the perfect rendering of lyrical songs by Schubert, Schumann, R. Franz, Brahms, &c. National songs of various countries—a treasure-house too little explored—should also find some place in their *répertoire*. These national songs express the genuine feelings of the people, and, if sung in an unaffected style, will always please a musical audience. As a fresh contribution to this province of song, I may be here allowed to direct attention to a new edition of Johannes Brahms' German Folk-Songs, translated by myself, and recently published in seven

[1] See my Preface to the English edition of Loewe's ballads. Schlesinger (Rob. Lienau), Berlin, and Weeks & Co., London.

volumes by N. Simrock, Berlin and London. As regards the so-called drawing-room songs and ballads daily manufactured in dozens, and unfortunately so much in fashion at present in this country, I must enter a decided protest against them. Worthless in themselves, and harmfully influencing musical taste, they deserve to be—and I trust before long will be—banished from the concert hall.

Though nothing has been added to, or altered in, the present edition, I hope new friends may be found to welcome a work specially aiming at practical usefulness. Those, again, who are already acquainted with its contents may judge it worth re-reading,—bearing in mind Quintilian's remark, that just as food requires the process of mastication in order that it may be more easily digested, so frequent repetition in reading assists intellectual assimilation.

In conclusion, I hope all my readers may have as much pleasure in following my advice as I have myself in offering it to them.

ALBERT B. BACH.

EDINBURGH, *November* 1894.

PREFACE TO THE FIRST EDITION.

THE title of this book indicates its contents. I wish to demonstrate in it how, in the art of singing, old and new, empiricism and science must be combined.

The art of singing is, in spite of the great progress we have made in science, still based on empiricism. Originally the old Italians built up the whole art upon it; and only in our time has it received a more scientific foundation through Helmholtz, and especially in his 'Vocal Theory.' The excellent physiological works by Merkel, Rossbach, Brücke, Ellis, G. Engel, Grützner, and others, have furnished fresh means for the advancement of the art; but it must still have the support of the experience of centuries, and will scarcely ever do without it.

Even Laryngoscopy has hitherto been of very little use in the development of the vocal art, as the forma-

tion of tone cannot be properly taught by its means; observations on the vocal chords can only be made on the vowel *ae*, and then it is necessary to have a foreign body in the mouth. The formation of tone under such conditions is too mechanical, and is indeed unnatural; the higher intellectual conception of tone is wanting. But the tone ought to be noble, poetical, and animated, and to be produced through inspiration, as only thus can we do justice to the art of singing.

It is as unwise to break with our empirical traditions, and to look down upon the old Italians with disregard, as to overlook the progress which the art of singing has made through science. We must, however, not overestimate the latter. Let us go impartially through the different sciences, examine and investigate how far they are of practical use in the art of singing, and then we shall find that empiricism must always help us in our studies.

Hypotheses which have repeatedly served to explain certain phenomena are considered laws, but they cannot permanently have the necessary authority, and are displaced by higher hypotheses. It is indeed a wise ordinance of Nature that without mechanical instruments we cannot see the working of our voice apparatus, and we can only feel what we produce with it; for, after all, Art is entirely an outcome of Feeling.

The most important thing in the art of singing—I mean the colour of tone—cannot be described; we must hear good and cultivated singers, and they must in our studies enlighten us, and be our ideals. If the teacher be only a good musician, and not at the same time a good singer, the proper study of tone-formation is out of the question. It is such teachers that we have to thank for the new but false theories—that the learner ought to begin the tone-formation with the vowel *u*, and that there are five registers to equalise in the human voice.

The excellent results we have obtained by the old method, in which Jenny Lind, Adelina Patti, Albani, Santley, Sims Reeves, Lloyd, Lasalle, and others have been instructed, prove that we should still cultivate and honour the old method, and adopt from the new only what is good and useful.

The vowel *a* (ah) is and remains for ever the king of vowels; poor *u* has, after a service of centuries, not reached the position of a chamberlain, since it still fills, literally as well as figuratively, only the humble function of a "door-closer."

As to the registers, I will here only say that in some voices we observe feeble notes, which sound weak and contrast greatly with their stronger neighbour notes. Such, like all uncultivated voices, we can only equal-

ise by the true Old Method, which consists in *piano* singing.

In our studies we must never leave the ground of experience, and lose ourselves in speculations. The scientific foundations of singing—namely, acoustics, physiology, and anatomy—I have not fully treated, confining myself to such an exposition of them as I considered to be useful for the singer and musician. The ear, however, I have treated with particular care, as it is well known to be the best guide and teacher in our studies.

In the anatomical part of this work there are no diagrams, for I have convinced myself by extended experience that they are confusing to the reader, unless he be a professional man. Anatomy should only be taught with the help of good models, as they are for the student the best means to study and understand the particular parts of the voice apparatus.

In order to give the student an idea of the vibrations of the vocal chords, I recommend the use of the model which I have spoken of in my work on 'Musical Education and Vocal Culture,' p. 129; but instead of the glass tube, an india-rubber tube should be used, for its flexibility allows the student to make and to see the experiments himself.

After the scientific part, I proceed to the theory of

singing, and finally to the practice of singing, in the form of daily vocal exercises. High voices should sing these exercises one or two notes higher.

Children's voices I have studied for years with particular care; and though I have in my earlier lectures made some observations on the subject, it is only in the present work that I have essayed a clear treatment and development of it. The vocal exercises for children's voices are written in a compass which can be advantageously used by children from the ninth year to the time of mutation.

I venture to hope that my method of reading music will be found practicable by my colleagues, and that my observations upon teaching will be adopted by them.

Much mischief has been done through the heedless and superficial teaching of singing in elementary schools. In the interest of art I hope there will soon meet a congress of capable and cultivated teachers and vocalists, who will come to some final decision upon disputable questions, will abolish false theories, and replace them with good ones.

ALBERT B. BACH.

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ACOUSTICS

ACOUSTICS.

HISTORICAL REMARKS.

THE science of acoustics was not unknown to the ancients, yet it has yielded mathematically reliable results only within modern times.

The Greeks distinguished between noise and sound; and the musical intervals were also known to them, the difference of pitch being to some extent correctly understood by them in its musical aspect: they did not know, however, how to express it according to the laws of physics as at present understood. Pythagoras expressed the musical intervals by means of numerical ratios, which he had discovered by an empirical physical process. There is a legend of extremely doubtful authenticity, according to which Pythagoras (born 534 B.C.), when passing a forge, heard the hammers of the workmen sound the intervals of the fourth, the fifth, and the octave. He ascertained the weight of those

hammers, with the result that their proportions to the one producing the tonic were $\frac{3}{4}$, $\frac{2}{3}$, and $\frac{1}{2}$. What is more certain is, that Pythagoras set forth the elementary law of vibrating strings, which he deduced from his observation that the octave, the fifth, and the major third of a note are obtained by reducing the length of a string to $\frac{1}{2}$, to $\frac{2}{3}$, or $\frac{4}{5}$, while the tension remains unaltered. He expressed this law by saying that the proportion of the octave is that of 2 to 1, that of the fifth of 3 to 2, &c. To illustrate this law, he invented the monochord. This instrument consists of a string stretched over a sounding-board, and supported by a movable bridge, by means of which it may be divided into portions of any length desired. A scale on the sounding-board distinctly indicates to what part of the string the bridge has been moved, so that the relation between the different intervals produced, and the corresponding lengths of string necessary to produce them, may be demonstrated to the ear and the eye by means of the monochord. The conception of musical relations was, with the Pythagoreans, a strictly mathematical one; that is to say, they devoted their whole attention to the mathematical relations of the notes, and the proportions of length of the string. Their mathematical theory differs from that of the present day chiefly in one point—namely, in the idea they had of the "third." The Greeks considered the interval of a third to be a discordant one, a dissonance; they determined all relations of notes by the progression of

fifths, whilst we, nowadays, determine them by the progression of fifths and thirds.

We find also some observations on acoustics in the works of Aristotle (384 B.C.), from which it appears that he knew that the air conducts sound to the ear; that sound is better heard at night and in winter than in the day-time and in summer, and that the cause of this fact was to be found in the absence of the heat created by the sun—"because," he says, "the sun is the principle of all motion." Aristoxenus (320 B.C.) wrote a theory of sound, and said, that the decision whether a sound was musically correct or beautiful lay solely with the ear.

Yet the Greeks' idea of music was very different from ours. They, for example, took great delight in the chirping of the cicada or grasshopper-like harvest-fly, and Anakreon even devotes to it one of his odes, while Homer compares the persuasive eloquence of the old men of Troy to a singing-match of those very insects. What pupil of a modern conservatory would detect anything musical in that monotonous chirp?

The ancient poets of Greece were at the same time musicians. They recited or sang their poetry. Their singing was always strictly adapted to the words, and was accompanied by an instrument suited to the spirit of the poem, and always closely following the singer's voice. The great effectiveness of these performances, however, must certainly have depended more upon their poetical than upon their musical power. Pythagoras,

like all other Greeks, believed that the octave, fifth, and fourth were the only intervals forming a concord with the tonic; and it is well known that during the whole middle ages the same opinion prevailed. It is easily seen how this prejudice hampered the development of part-music, and of the theory of harmony. Towards the close of the middle ages, and in modern times, the theory of harmony has progressed in company with the theory of acoustics. Giuseppe Farlino, the reformer of modern music (born 1517, died 1590), in his celebrated work 'Instituzione Harmoniche,' established the pure diatonic system, and introduced the equalised temperament of the scale, without which the development of modern music would have been impossible. Up to the time of Farlino the Pythagorean system had maintained its ascendancy. As regards the progress of acoustics, it mainly comprises experiments on the velocity of sound in air, in water, and in solid bodies, the dependence of the intensity of sound upon the more or less dense condition of the air, and so on.

Some remarks referring to acoustics are to be found in the works of Francis Bacon (born 1560), who distinguishes between tone or note and sound, and says that the former is brought about in a regular, the latter in an irregular manner. Francesco Galileo (born 1564), by watching the swinging of a lamp suspended from the roof of a church in Pisa, discovered the law of the oscillations of the pendulum. Having made this discovery, he took a most important step in advance, and

established a close similarity between the laws of the motions of sound, those of the vibrations of strings, and those of the oscillations of the pendulum. We have still to mention another observation of his upon acoustics: he discovered that the water in a tumbler, if the wet finger is drawn over the edge of the glass, forms circular waves on its surface as soon as a tone is elicited. The higher the note, the more closely the wave-circles approach each other.

The velocity of the propagation of sound in the air was also measured by Gassendi (born 1592), Mersenne (borne 1588), Boyle, Picard, and others. Their determinations were arrived at in quite a rational manner—through observation of the time which elapses between the flash and the report, when a gun is fired at a given distance. Gassendi had already made the observation that the velocity of sound is independent of its pitch. But the influence of disturbances in the air was not then recognised. W. Derham (born 1657) first examined into the different influences which affect the velocity of sound. He found that the velocity of the wind modifies the velocity of sound. Guericke (born 1560) invented the air-pump, and proved by its means that a bell suspended in a vacuum produces no sound. He was also acquainted with the power of water to propagate sound, seeing that he could attract the attention of fish by means of a bell.

Mersenne observed the fact that a string emits, besides its tonic, two upper notes or harmonics, and that the

pitch of a sound is conditioned by the number of vibrations executed in a second. After this it was no longer the length of a string that was employed as a means of specifying the pitch of a given note, as it had formerly been since the time of Pythagoras and the ancients, but now the number of vibrations came to be stated instead. W. Noble and Thomas Pigoss discovered in the seventeenth century that a string vibrates not only in its entire length, but also in its halves and thirds; and the notes corresponding to these halves and thirds are to be heard accompanying the main tone, being known as harmonics. Wallis, the teacher of the above-mentioned writers, published this result in 1677. Independently of these investigators, Sauveur (1655-1716) also discovered the harmonics.

Rameau (born 1683), Taylor (Secretary of the Royal Society, born 1685), Count Ricati (born 1709), Tartini (the celebrated violinist, born 1692), and M. Young (born 1750), were also engaged in the study of acoustics.

E. Fr. Chladni (born 1760) did great service in the development of the theory of acoustics. He was an investigator possessed of all the information requisite for the successful pursuit of the various branches of acoustics. The method of employing metal plates, rods, and bells, set in vibration by the violin bow for the purpose of acoustic experiment, was originated by him. He also invented two musical instruments—the euphon, consisting of glass rods, and the clavicylinder, a piano

with glass rods instead of strings. He delivered lectures on acoustics and other musical subjects in the largest towns of Europe—as, for example, in Paris in 1808, where Napoleon witnessed his experiments with much interest. He died in 1827, his most celebrated work being 'Acoustics,' 1802, of which, at the particular request of the Emperor Napoleon, he issued a translation under the title 'Traité d'Acoustique' ('Schallklanglehre,' 1827).

The most important achievement in acoustics is the acoustic theory of Ohm (born 1789). He says: "Every sounding body produces, besides its deepest and most powerful note, the *tonic*, and simultaneously with it, several higher or upper notes—the harmonics—whose vibration-number is two or three times as great as that of the tonic." Any musical sound is a "consonance of simple harmonic tones," and this definition supplied the basis for Helmholtz's celebrated work upon acoustics. Helmholtz succeeded in contriving apparatus for rendering the upper notes evident to the ear, by means of resonators. Besides these writers we may mention the names of Sophie Germain, Felix Savart, Seebeck, F. Fourier, Ch. Cagnard de la Tour, inventor of the siren, an apparatus by which absolute pitch can be determined,—and many others.

Many a problem as to acoustics remains still to be solved: thus, for instance, music-halls and theatres with very bad acoustical properties are still being built; and there are even halls, &c., identical in their dimensions

and yet producing different effects as to sound. And thus, notwithstanding the result of all the most recent researches, it has been possible only to a certain degree to approach the perfection in which Stradivarius once created his violins. It is therefore reserved for the future to solve many mysteries of acoustics.

ACOUSTICS.

What is Sound? What is Tone? These questions will necessarily present themselves to every thinking musician who occupies himself with the wonderful phenomena which come under his special observation. Acoustics is the science which gives us the desired information, for its object is to trace and define the nature of sound.

Sound as well as tone is a progression of oscillating motions which proceed from vibrating bodies, and which advance through the air in wave-like beats or undulations, finding in our ear an organ for their perception.

The air, as we see, is the carrier of sound, and thus not only satisfies one of the chief requirements of our existence, but also adds to it the most manifold and refined enjoyment. How beautiful are the silent woods! yet how much more beautiful when in them the feathered songsters raise their voices to praise the Most High! How elevating the impression upon us of Handel's Hallelujah when presented by a well-tutored choir! These enjoyments we owe to the sound-conveying air;

for the concussion and motion of the air are essential conditions of our sensation of sound. Sound cannot be propagated in a vacuum. Accordingly, the greatest noise on earth cannot proceed beyond the limits of our atmosphere; and in the same way, not the slightest sound can penetrate to our earth from any of the heavenly bodies. The most dreadful explosion might occur on the moon's surface, and Venus be rent into a thousand fragments, without our *hearing* anything of it.

But we need not mount so high to convince ourselves of the truth of this statement. Let us have a glass chamber from which the air is completely exhausted, and in which a bell is suspended; and let us bring this apparatus quite close to our ears, and then set the bell in motion: we shall not hear the slightest sound. The reason is, that the concussion produced by the striking of the bell meets in its immediate vicinity no air which it can again put in motion so as to conduct any air-waves to our ear.

The undulatory motion by which sound is propagated consists in the alternate condensation and rarefaction of the air in which the wave thus formed expands in the shape of a globe. The air must therefore be of a certain density in order to act as a conductor of sound. Thus, on the summit of Mont Blanc a pistol-shot causes a report less than that of a pop-gun fired in the plain below; and we observe that in very rarefied air the power of the voice greatly diminishes.

Gay-Lussac in his balloon found that, at a height of

7000 metres, the strength of his voice was reduced to that of a weak boy. On Mount Chimborazo the perceptions of our ear would be still more faint, and the most powerful bass voice would sound like that of an infant, because the air is too much rarefied to afford to the sound-waves a medium adequate to their propagation. It is stated that in the arctic regions, at a temperature of 35° Fahr. below zero, two persons can conveniently converse with one another across a space of more than an English mile. It is easy to understand that rain, as well as fog, considerably weakens the power of sound, inasmuch as the intervention of foreign particles, such as drops of water and fog-globules, impedes the motion and continuity of atmospheric undulations.

At various places experiments have been instituted to determine the velocity of sound. Humboldt found that, at a temperature of 68° Fahr., it travels 1090 feet per second. The velocity increases with an increase of temperature, and it decreases as the temperature falls. The more uniform the medium, the more even and undiminished in strength the propagation of sound. *In a calm, sound progresses in all directions; influenced by wind, it generally yields to its direction.* At night-time, when the density of the air is more uniform, we hear better than in the day-time, when the solar rays cause marked inequalities in the density of the air.

When sound-waves encounter resisting surfaces, they are thrown back. A reflection of the sound ensues,

which is perceived either as a reverberation, or, under certain circumstances, as an echo. Smooth surfaces favour reverberation, so that the perception of the original sound or tone is disturbed. Empty apartments, therefore, give forth reverberations; while in large halls a break in the line of wall, or the intervention of niches, pillars, and galleries, is often serviceable towards promoting distinctness in the perception of sound. When sound is reflected from a surface sufficiently remote, the secondary sound which ensues is termed an *echo;* and when the atmospheric undulations cause audible vibrations in a second body within the range of influence of the original sounding body, these consonant vibrations constitute what is known as *resonance.* The peculiar singing, for instance, which the ear perceives in sea-shells, finds its explanation in the fact that the air confined within the shells repeats and increases the slight noises occurring in the surrounding atmosphere. Consonance is most marked between bodies having the same number of sound-vibrations—*i.e.,* bodies the sound of which is of the same pitch.

One of the chief parts in many musical instruments is a body of thin wood of great elasticity, which possesses the faculty of sharing in all the vibrations of the sounding body—in other words, of strengthening the sound. In the piano this important part is the sounding-board; in the violin, the body; in the human voice, the cavities of the chest, mouth, and nose supply the resonance.

Usually it is the air that propagates sound; but, besides this, other bodies may serve as conducting media. Thus wood, metals, glass, water, and such-like, all constitute more or less efficient conductors of sound. Wood, for instance, conducts sound much better than air. Thus, if we lay a watch on a table covered with a soft cloth, we would at a certain distance not be able to hear the ticking of the watch; but if we bring one end of a wooden rod into contact with the watch, and apply the other end to our ear, we shall most distinctly hear the watch ticking. Solid bodies accordingly conduct sound better than air. Even the untutored races of hoary antiquity knew that by applying the ear to the ground, an approaching troop of horsemen could be discerned while still at a great distance, and thus they were often forewarned of intended surprises.

That water also is a conductor of sound may be easily demonstrated by knocking two stones against each other while diving.

Every strong sound is accompanied by perceptible vibrations—a fact of which we may convince ourselves on taking a walk in the vicinity of Edinburgh Castle at the time when the one-o'clock gun is fired; for then we will not only notice the shaking of window-panes in their frames, but we may also observe persons near us to be visibly affected by the concussion of the air.

The velocity of sound greatly varies with the material of the conducting body. The speed of sound in tin

is 7½ times; in silver it is 9 times; in copper nearly 12 times; and in iron and glass 17 times greater than in air.

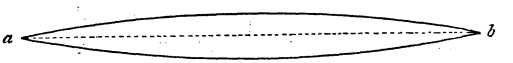
Everything audible we call a sound; but, on the other hand, we call a sound of determinable limitation as to height or depth, a *tone* or note. Tone arises from the regular vibrations of elastic bodies. Sound can be produced by all bodies capable of resistance, if they are disturbed from their position of rest; but elastic bodies—as, for instance, wood, metals, air, and water—emit sound only when excited to vibrations of sufficient intensity, as is the case with strings, plates, and rods of metal, confined air, &c.

In the piano and other stringed instruments, the strings are the sound-producing body; in wind instruments and the human voice, the sound is produced by a certain mass of air. The sound-motion can be effected by a current of air, or concussion, or by friction with some other solid body, and the manner of such motion may be either regular or irregular. Irregular motion produces merely noise, and only regular motions give us tones or notes.

The power of distinguishing between noises and musical sounds depends, moreover, on the sensitiveness of our ears. It is related of a Chinese ambassador, who was witnessing a performance of Wagner's "Lohengrin" at the Imperial Opera-House in Vienna, that he evinced the greatest delight as long as the musicians were tuning their instruments, but that his enthusiasm

vanished with the commencement of the glorious overture; and he then left the house, declaring that he would no longer listen to such a disturbance.

Alternate motion to and fro is termed vibration. There are transverse and longitudinal vibrations. By "transverse" vibrations are understood the deflections of a body from side to side, such as we observe, for instance, in a string—



Longitudinal vibrations, on the other hand, are alternate contractions and expansions in length. Strings, metal rods, and drum-skins perform transverse vibrations. Columns of air confined within organ pipes have longitudinal vibration. Transverse vibrations, accordingly, occur in the piano and all stringed instruments; longitudinal vibrations are common to all wind instruments.

One complete movement to and fro is called a *vibration*, and the time required for such motion is termed the *time of vibration*. The space covered by the motion is called the *amplitude of vibration*, and the sum of the vibrations performed in a second is the *vibration-number*.

Pitch of a note.—A definite number of vibrations produces a definite note, and the pitch of any note depends on the number of vibrations which the vibrating body performs in a second. We observe that the

less the number of vibrations—*i.e.*, the fewer and slower these are—the lower is the note; and *vice versâ*, the greater the number of vibrations—*i.e.*, the more rapid and numerous they are—the higher the note. This rule is not in the least affected by the nature of the vibrating body.

Each individual note, therefore, has its own definite number of vibrations; and, again, each given number of vibrations answers to a definite note.

Loudness of sound.—If we observe a string as it is struck or played upon, how at first it performs rather extensive vibrations, then moves to and fro over a gradually decreasing area until it finally resumes its state of rest, we notice that the sound is loudest at first, and becomes gradually weaker, until at last it entirely ceases. According to the greater or less force with which a string is struck, its vibrations are of wider or narrower compass, and the tone is either strong or weak. Thus we see that the loudness of sound depends on the amplitude of vibration.

We observe similar phenomena in the action of the vocal chords in the human larynx. When powerful chest-notes are being sung, these chords vibrate in their entire breadth; whereas only their edges vibrate when delicate falsetto-notes are given out.

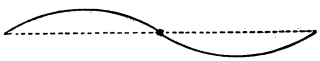
We have mentioned above that every note has its definite vibration-number; and it is further to be noticed that the notes available for musical purposes range in number of vibrations from 33 to more than

4000 in the second. The lowest C on our pianos, which corresponds to the 16-foot open diapason of the organ, makes 33 vibrations to the second, and the five-stroked C of the piano has 4224 vibrations.

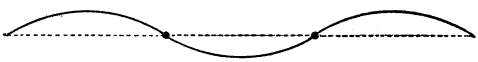
While the height of the note thus depends on the number of vibrations, the question may be put—On what does the vibration-number itself depend? Manifestly on different conditions with different sounding bodies. In the case of strings, the number of vibrations depends on the length, the thickness, and the tension; and in that of columns of air (as in wind instruments) it depends on the length, the force of the current of air, the position of the mouth, and on the temperature. The longer and thicker the string, and the less its tension, the less is its vibration-number (or the slower its vibrations), and hence the lower the note. On the other hand, the shorter and thinner the string, and the greater its tension, the greater is the vibration-number (or the more rapid the vibrations), and accordingly, the higher the note. The pitch of the notes of wind instruments depends chiefly on the length of the air-column they contain: the longer this column is, the lower the note; and the shorter the column, the higher the note. The relation of the length of the string to its vibration-number, and that of this number to the height of the note, appear from the following:—

The length of the string and the vibration-number are in an inverse ratio—*i.e.*, one half of the string makes twice the number of vibrations, one-third of it makes

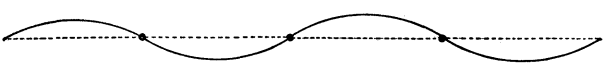
three times the number, and so on. If we divide or stop a string by pressure at certain points, the following forms of vibration may ensue:—



In two parts.



In three parts.



In four parts.

The points stopped remain at rest, and are termed the "nodes of vibration" (this term *nodes* was introduced by Sauveur about 1683). The acoustic proportions resulting from the above are—

Length of string.			
$\frac{1}{2}$	double the vibration-number,	$\frac{2}{1}$	= the octave (of the tonic).
$\frac{1}{3}$	three times "	$\frac{3}{1}$	= upper fifth (the twelfth).
$\frac{1}{4}$	four times "	$\frac{4}{1}$	= 2d octave.
$\frac{1}{5}$	five times "	$\frac{5}{1}$	= third (in the third octave).

The proportion of the simple fifth (pure fifth) is $\frac{2}{3}$ the length of the string and $\frac{3}{2}$ the vibration-number (*i.e.*, $\frac{1}{2}$ more). The proportion of the simple (major) third $= \frac{4}{5}$ the length of the string and $\frac{5}{4}$ (an additional $\frac{1}{4}$) of the vibration-number of the tonic.

All the other acoustic proportions answer to rela-

tions between length of string and the vibration-number.

The acoustic proportions of the scale, along with the corresponding lengths of string and their vibration-numbers, are expressed in the following:—

Notes.	C	D	E	F	G	A	B	C
Length of string	1	$\frac{8}{9}$	$\frac{4}{5}$	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{3}{5}$	$\frac{8}{15}$	$\frac{1}{2}$
Vibration-number	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	$\frac{2}{1}$

These proportions (fractions) all refer to the tonic: thus the second note (the major second) has $\frac{8}{9}$ of the length of string of the tonic or first note, and $\frac{9}{8}$ ($1\frac{1}{8}$) times its vibration-number—*i.e.*, $\frac{1}{8}$ more of vibrations than the tonic. Again, the third note (or major third) has $\frac{4}{5}$ the length of string of the tonic, and $\frac{5}{4}$ ($1\frac{1}{4}$) its vibration-number—*i.e.*, the number of its vibrations exceed those of the tonic by $\frac{1}{4}$; and similarly with all the remaining notes.

TEMPERAMENT.

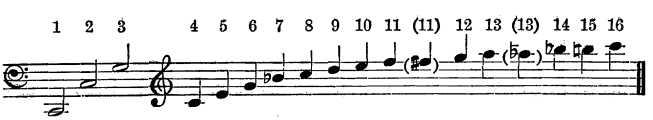
On instruments like the violin, on which the player can modify or regulate the pitch according to will, every scale can be played with perfect purity. On instruments, however, with fixed pitch, such as the piano,

it is not always possible to preserve perfect purity of interval; and on the pianoforte one and the same note is struck for C sharp and D flat, one and the same for F sharp and G flat, and so on. If the tonic makes one vibration in a given time, its major third must during the same time perform $\frac{5}{4}$ of such vibrations, and the major third of the third must perform $\frac{5}{4} \times \frac{5}{4} = \frac{25}{16}$, and the succeeding third of that third $\frac{5}{4} \times \frac{5}{4} \times \frac{5}{4} = \frac{125}{64}$. This last note, which would appear on the piano as the octave, does not exactly accord with the real octave, which demands $\frac{128}{64}$ vibrations.

Progressing, then, in true thirds, one does not arrive at the true octave; and if one wishes to preserve the purity of the octave, one has to set aside the perfect purity of the thirds. Similar conditions arise in the progression by true fifths. One is, therefore, in order to preserve the purity of the octaves, compelled to tune the notes somewhat more sharp or more flat than the true relation of thirds or of fifths would demand. One must allow the tone to hover in the balance, so to speak, either a little above or a little below the true interval; and this equalisation of intervals is called Temperament. The simplest system, and that most generally employed, is the so-called equal temperament. According to it, the entire octave is divided into twelve perfectly equal intervals, so that the difference between large and small semitones and between large and small full tones is abolished.

HARMONICS (Upper or Partial Tones).

In the study of musical sounds the following phenomenon is of pre-eminent importance. When we hear a note we imagine that it is this one note only that is sounding. This is, however, a mistake, for on closer examination we discover that simultaneously with that note, or tonic, a number of other notes become audible, which have been called the *natural upper or partial tones*, more commonly "*Harmonics*." These tones are produced in conformity with the law that a sounding body vibrates not only as a whole, but also in parts. A sounding string, for example, not only performs its primary or tonic vibrations, but also, besides, its secondary or harmonic ones in the manner already indicated —*i.e.*, vibrations in 2, 3, 4, 5, 6 parts, and so forth. From these part-vibrations, consequently, result the intervals shown in the following table, in which the fundamental tone or tonic is C:—



After this there occur chromatic and continually decreasing intervals. The figures above the notes do not merely indicate their consecutive order, but also the parts of the string emitting the respective harmonics. 1 represents the tonic and also the entire

length of the string; 2 denotes the second note (first harmonic) and likewise the half-length of string; 3 signifies both the third harmonic and the third of the length of string,—and so on.

The doubling of the figure always designates the octave: thus, of 2 (the octave) the doubles are 4, 8, 16, all of which are the higher octaves. Of 3 (the fifth) we have 6 and 12 as the ciphers indicating its octaves. Of 5 (the third) we have 10, and of 7 (the seventh) we have 14 as their octaves.

In reality the 7 is somewhat lower than the "*seventh*" in musical practice, 11 somewhat higher than the pure "*fourth*," and 13 again somewhat lower than the major "sixth."

In the harmonics the natural fundamental relations of harmony are given, and furthermore, in them all possible modulations are contained. Harmony is therefore based on natural laws.

The human voice is peculiarly rich in harmonics, but these are not discernible by the unaided ear, and only become audible by means of acoustic experiments. In the case of vibrating strings, on the other hand, it is not difficult to observe that the *tonic* is accompanied by harmonics. With mere ordinary attention one can, without the employment of extraneous contrivances, perceive by the ear alone the presence of the *third harmonic*. This note is heard the more distinctly, the more the tone of the string decreases in power, because the *tonic* loses in intensity more rapidly than the third, and

consequently allows the latter to become more prominent. The *fifth harmonic* is also easily heard. More difficult of perception are the *second* and *fourth harmonics*, because they represent the first and second octaves of the tonic, and are apt to be confounded with it.

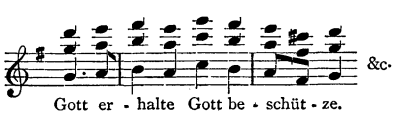
In the same way, when striking the low *C* on the piano, one hears distinctly the octave of the *G* above that *C*, which is its *third harmonic;* also the *c* of the next octave, which is its *fourth harmonic.* Thus, as we have seen, the harmonics are easily produced on the piano by striking the lower notes. The Eolian harp, exposed to a current of air, emits them with great distinctness; and the same is the case with telegraph wires agitated by the wind.

Professor Rossbach very clearly illustrates the simultaneous sounding of the *tonic* with the *harmonics* thus:—

"Let us imagine a tall, graceful tree which, with its stem, its boughs, its branches, and its leaves, certainly presents to us a unit in spite of its composition out of many individual forms. With a strong breeze rushing through it, these, its various parts, are, each according to their bulk, agitated in different degrees and manners. While the stem is executing slow and stately oscillations, the boughs already move in much quicker time, the branches even more rapidly, and the leaves are performing a hundred vibrations on their stalks during the time occupied by a single oscillation of the stem.

And while watching these movements of parts, we at the same time perceive their various effects upon the ear. The tall, swaying stem is groaning and creaking (*the tonic*), the boughs are rattling against one another (*the lower harmonics*), the wind is striking on them as on sharp edges, and is beginning to whistle, while the thousands of leaves which are brushing and flapping against each other are creating a rustling and whizzing noise (*the upper harmonics*). In watching these phenomena from a greater distance, at which we can no longer clearly distinguish individual motions and individual parts, we shall perceive that the tree is going through a general or leading motion—viz., that it, with all its boughs, branches, twigs, and leaves, is swaying to and fro. The diverse noises which we were able to distinguish when near at hand are blended into one roar, and it is only by dint of close attention that we succeed in making out the separate distinguishing noises."

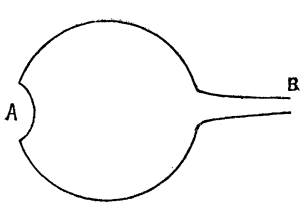
It is well that the unaided ear does not perceive the harmonics of the human voice; for, were we to hear even the first and second harmonics of each note, we should hear every melody with the continuous accompaniment of a higher parallel-fifth—*e.g.*, in Haydn's:



And if we were, in addition, to hear the *third* and

fourth harmonics, we would perceive every note accompanied by a superimposed *major-triad*, which certainly was not in the intention of the melodious Haydn. Nevertheless the harmonics in the human voice play a very important part, inasmuch as the colour or "*timbre*" of the voice depends on the greater or less number, and the greater or less intensity, of the harmonics, in proportion to the volume of the tonic—a matter which we will presently enter upon more fully.

If we desire to assure ourselves of the existence of the harmonics, we find the best means in Professor Helmholtz's resonators, which intensify, and thus make manifest to us, every possible harmonic, however feeble. These resonators, set to the pitch of the several harmonics, may with propriety be called *tone-intensifiers*. They are either of glass or metal; or one can, with small outlay, be constructed of an india-rubber ball, with strong walls. As we see from the accompanying diagram, they have an aperture (A) open to receive sound, and on the opposite side a narrow tube (B) to be inserted into the ear. According to its capacity and the diameter of the exposed aperture A, the air contained in each resonator has a tendency towards a vibration, in accordance with a note of a particular pitch — one resonator for *C*, a second for *G*, and so on.



Whenever one of these notes is started by the voice or some instrument, it immediately calls forth the resonance—*i.e.*, the co-vibration of the volume of air contained within the globe—and thus affects the ear more powerfully than a note differing in pitch. It is by means of these resonance-globes that Helmholtz demonstrates the presence of all the harmonics pertaining to any single note. Each musical instrument has a number of harmonics—the one more, the other fewer; those of the one stronger, of the other more feeble.

To prove without the aid of resonators the existence of harmonics, the following experiment may be resorted to: If we sharply strike the low *C* of the piano, at the same time *with loud pedal* pressed down, merely holding down the *c*, *g*, *e*, next above, we will, with a little attention, hear these notes in co-vibration.

It would thus seem that the note *C* elicits notes by which the strings of *c*, *g*, *e* are agitated—*i.e.*, set in co-vibration. These tones, then, are the harmonics. Even the eye may convince us of the existence of harmonics; for if we place on any string of a piano—in this instance on the upper *C*—a little chip of wood or a small piece of paper, we will see it removed from the string the moment that we strike the lower *C*—a result arising from the intervening co-vibration of the upper *c* string. If, on the other hand, we place the paper on the string of *C* sharp, it will remain quietly there when *C* is struck; for the string on which the paper is lying does not participate in the vibration of the tonic-string.

The relation of the intervals of the harmonics to the tonic of the chord is invariably the same: these are always the octave, the diatonic twelfth, the double octave, the third of the double octave, the fifth of the double octave, and so forth, appearing with more or less intensity as the harmonics of the tonic. The note *G* contains, besides the tonic, the harmonics *G*, *d*, *g*, *b*, *d'*, *f'*, *g'*, *a'*, and so forth. The note *E* consists of *E*, *B*, *e*, *g* sharp, *b*, *d'*, *e'*, *g'* sharp.

The harmonics become more and more feeble the higher they are—to such a degree, indeed, that in musically available sounds it is principally only the lower harmonics that are heard at all distinctly. To singers we would recommend that they should, by way of practising the ear, occasionally trace the harmonics on the piano, by which means they would, besides, be enabled readily to state the notes of any chord. A practised singer, especially one used to part-singing, will always know to resolve any chord into its component notes, yet will owe this advantage to constant attention and practice only.

The attention of beginners may, in the following manner, be directed to the harmonics in any particular note. Touch softly the *g* on the piano, quickly withdraw the finger, and wait till the note has entirely ceased to sound, while keeping it, however, carefully in mind. Now strike C, and with close attention the fifth above, or the *g* first sounded, will be distinctly heard.

TIMBRE, OR TONE-COLOUR.

By *timbre* we understand that peculiar quality of a note, whatever may be its pitch or intensity, owing to which there is a difference between the same note as sounded by the voice and as sounded on an instrument, or between the same note as sounded on different instruments. *A note produced by the human voice differs in timbre from the same note sounded on an instrument. The bass has a timbre different from that of the soprano, and the piano from that of the 'cello,* and so forth.

Timbre, or *Tone-colour,* arises from the harmonious consonance of a number of harmonics. As a rule, the first octave above the tonic is in consonance with the following fifth or the second octave. Under certain circumstances from 8 to 12 harmonics may be in consonance, and the greater their number the richer will appear the colour of the tone. The *timbre* depends on the intensity of the individual harmonics, and everything which alters the strength of these influences the tone-colour.

At times, indeed, a note unaccompanied by consonant harmonics may be very lovely, but it is at all times thin and poor. This is the case with tuning-forks. The closed pipes of an organ, also, have scarcely any consonant harmonics; their tone becomes obscured, and may be compared to the sound of the vowel *u.*

When the tonic is accompanied by the lower har-

monics 2, 3, &c., it acquires a full mellow character; but if, on the other hand, the consonant notes are the higher harmonics, the tonic assumes somewhat of a sharp, shrill, blaring nature, as in the case of trumpets. The most agreeable are those full notes, the tonic of which is accompanied only by the six first harmonics, when of moderate power. In this quality the higher notes are entirely wanting. Helmholtz found that, in the case of the violin, as compared with the guitar or the piano, the tonic is strong, the accessory sounds from 2 to 6 are weak, while those from 7 to 10 assert their presence much more clearly. In the case of the clarionet, only those accessory sounds represented by uneven numbers—3, 5, &c.—are perceptible; and again, on examining the oboe, we see that with it the accessory sounds to which even numbers pertain are the most powerful. Notes to which the even-numbered harmonics (octave, 2d octave, &c.) are wanting are hollow and nasal—an effect which also ensues, though to a lesser degree, when only the odd-numbered (the diatonic twelfth or its octave) are absent. The note produced by blowing into a bottle will be found a hollow one, because the hearer fails to discover any harmonics accompanying the tonic. The human voice abounds in harmonics, though it is difficult to perceive them, owing to their being too much blended with the tonic. *Timbre* exists only as long as all the harmonic components of a note over and above the tonic are indistinctly heard. We hear those harmonics best as separate notes which

are dissonant from the tonic, as is the case with bells.

From the above remarks we see that difference in the quality of *timbre* has its origin in the accession or subsequent addition of harmonics. We hear manifold variations in *tone*-colour, according to the mode of production and treatment of a note. With respect to string-instruments the following may be observed:—

When the strings are struck by means of a point or peg, as in the case of the zither, or touched with the nail of the finger, as occurs with the harp or guitar, or when they are struck with a hard unelastic hammer, one obtains a sharp ringing note, having a great number of high harmonics. But these latter do not occur, and the tone becomes less shrill, and more soft and melodious, when the string is touched with the soft part of the finger or with an elastic hammer. If the harmonics are too strong in proportion to the tonic, the note becomes thin, to avoid which defect the hammers of a pianoforte are covered with elastic, felt, or leather. A further circumstance, influencing the composition of the sound, is connected with the particular point at which the string is struck. When, for instance, the string is struck right in the centre, all the even-numbered harmonics disappear, while the odd-numbered ones are heard, and the note becomes somewhat hollow and nasal.

When the point of contact is at one-third the length of the string, the 3, 6, 9 harmonics are absent, which

also causes the sound to be somewhat hollow, though not to such an extent as when the string is struck at its middle point. If, again, the string is struck very near to either end, the note becomes poor and tinkling, because at the expense of the tonic and the lower harmonics the very high harmonics assert an unpleasant influence. In pianos, the point at which the hammers strike the strings of the middle octaves is at one-seventh or one-ninth of the length, which, as experience shows, produces tones musically the finest and most serviceable,

The material, too, of which a musical instrument is constructed greatly influences its *timbre:* a trumpet of wood, for example, would, though similar in every other respect, have a sound very different from that of a trumpet made of metal.

The tones of organ-pipes vary according to their different modes of construction. We distinguish two kinds—viz., labial and tongue pipes, which are also called respectively mouth-pipes and reed-pipes. In the first the vibration is effected by a current of air only, without the aid of any solid body. In this case the tone depends on the column of air only. In tongue-pipes the air is directed so as to move the reed—an elastic little plate, which communicates its vibratory motion to the body of air enclosed in the tube. To this class of pipes belong, in addition to the reed-pipes of the organ, the clarionet, the oboe, and the bassoon.

As regards the *timbre* of reed-instruments, it de-

pends very much on the presence or the absence, in connection with the reed, of a lengthening tube.

In free reeds, vibrating without a lengthening tube, the single simple tones pass straight into the surrounding air, and therefore always have a sharp, cutting, or jarring sound, accompanied by a long series of harmonics. The lengthening tubes, then, alter the *timbre* of the reeds, inasmuch as those harmonics which correspond to secondaries proper to the lengthening tube are here considerably strengthened, and therefore become more prominent.

The most remarkable of all instruments is the human larynx. In this the elastic vocal chords take the place of membranous reeds, and by means of their tension the pitch of the note is determined. The cavity of the mouth acts as a lengthening tube; and as this tube (the superlaryngeal), on account of its elasticity, is capable of assuming varying dimensions in width and length, and of resounding to notes correspondingly changed in pitch, sometimes one, sometimes another of the harmonics of the tone is intensified: in other words, all those harmonics which correspond to, or at least approximate sufficiently to, the harmonics proper to the cavity of the mouth, can be intensified, whereas the remaining harmonics become more or less subdued. When once we have acquired the secret of the cavity of the mouth, and know how to give to it the form demanded by each particular expression, we shall be able by the various shades of tone to excite admiration in quite as

high a degree as a great painter may by the judicious arrangement of his tints.

Yes, the cavity of the mouth is indeed a wonderful spot! It is another Fingal's Cave! Just as the basaltic columns in that cave ring and sing when the waves of the sea lap against them, so the cavity of the mouth is not adapted for resonance only, but is also specially tuned, and in each definite form and position has a definite pitch of its own. According to the varying position of the lips, the cheeks, and the tissues within the mouth, we hear, even in the mere whispering of a vowel, sounds of different pitch.

We must be careful to note that the vowels as such are not formed in the larynx, but that each of them receives its peculiar *timbre* from the superlaryngeal tube, the cavity of the mouth. Only notes of primary pitch arise in the larynx through the instrumentality of the vocal chords, these being caused to vibrate by the air issuing from the windpipe.

If the air enclosed in the open cavity of the mouth is indeed susceptible to any special vibration, and if a vibrating tuning-fork is applied to the open mouth, its tone will be intensified by resonance whenever the pitch of the tuning-fork is the same as that of the air in the cavity of the mouth, but not otherwise.

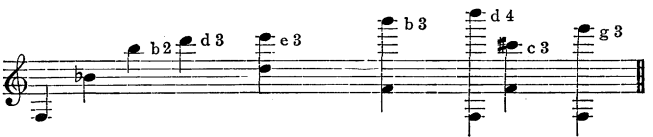
The following experiment will further elucidate this point. If we hold a tuning-fork, tuned to *b*, before the cavity of the mouth, while the latter is opened as if to produce the sound *o*, the air contained in the cavity

rouses the resonance, and we hear the sound of the tuning-fork materially enhanced. In the same way, if we take a tuning-fork at the pitch of *a″*, and then open the mouth as if for an obscure *a*, we shall likewise produce the phenomenon of resonance. For *e* (= *eigh* in neigh) a tuning-fork pitched on *b″* flat is used. Of course there are many shades in the *timbre* of vowels, and we cannot describe all their niceties of variation, but, with a little practice, any one may easily find the exact position of mouth suitable to each tuning-fork pitch. From what has been stated here, it will be seen that the *more obscured* vowels verging on the *o* have a lower note, whereas the clearer ones have a higher note.

I would here direct attention to another point. It is interesting to observe how singers can, by the *timbre* they use, mislead even the most experienced of musicians. If, for instance a bass singer sounds *c′* sharp, using the obscure *timbre*, the note will appear lower, and the hearer will think he hears *c* natural; if, on the other hand, the clear *timbre* is used in sounding *d′*, one often seems to hear *e′* flat, or even *e′* natural; and hence it arises that an air written in *E* major would, if sung in the obscure *timbre*, sound as if written in *D* major.

NATURAL TONES OF VOWELS.

According to Helmholtz, the following represent the natural tones for the different vowels, or the resonance of the cavity of the mouth peculiar to them:—



We have here to draw attention to the fact that the cavity of the mouth forms one single hollow when adapted to the vowels *u*, *o*, *a*, but that it forms two separate cavities for the vowels *e* and *i*, and *ä*, *ö*, and *ü*, because the tongue, in order to form the five latter sounds, is arched upwards against the palate. The cavity of the mouth is in this respect like a bottle, which has likewise two natural tones—a higher one produced by the neck of the bottle, and a lower note produced from the body of the bottle. Therefore it is that we notice, in connection with the last-named vowel-sounds, that they are expressed by two notes. We would once again revert to the influence which the pitch of the cavity of the mouth exercises on the *timbre* of the voice; for when we sing, all those harmonics are intensified which coincide with the natural tones of the cavity of the mouth, or which are at least sufficiently

approximate to them, while the remaining harmonics are more or less subdued.

The natural tones of the cavity of the mouth are independent of age and sex. Helmholtz, as a rule, found the same resonances in the case of men, women, and children. The natural deficiency in capacity which shows itself in the mouth-cavity of women and children may easily be made up for by closing the aperture of the mouth more or less, so that the resonance may still be as deep as that of the larger cavity of the mouth in men.

In addition to this, we must notice that the pitch of the vowels is altogether independent of the different octaves—nay, even of the key in which the vowels happen to be spoken or sung. They are just the natural tones of those vowels or of the cavity of the mouth. The vowel *o* answers to the one-stroked *b′*, and to no other note. It may of course be spoken or sung to other notes, but *b′* is, so to speak, its home in the domain of tone. If sung on *b* an octave lower, the first harmonic happens to coincide with *b′;* the mouth, tuned to *b′*, at once assimilates the latter sound, and increases the fulness of sound of the tone produced to the vowel *o*. The differences in the harmonics of the various vowel-sounds may be readily recognised by means of the resonators. If one employs a resonator pitched to *b′*; and if one makes a singer, with a true intonation and accustomed to a correct formation of the vowels, sing to any one of those lower tones among the harmon-

ics of which we find *b'*—such tones being, for example, *b* or *e*, or *B*, *G*, or *E* flat—the different vowels in succession with uniform force; then it will be found that on singing the clear, full *o*, the *b'* of the resonance-globe will ring into the ear with great power. Next to this, the same harmonic sounded on a vowel midway between *a* and *ö* will be found still fairly powerful; it will be weaker sounded on *a*, *e*, *ö*, and feeblest on *u* and *i*. It is likewise not difficult to perceive that the resonance of *o* markedly decreases in strength, either when it is sounded more obscurely, so as to verge on *u*, or when it is more openly formed, so as to merge into *a*. If, on the other hand, we take the resonance-globe an octave higher—*i.e.*, for *b''*—the vowel *a* will be found to evoke resonance more powerfully than any of the others; whereas the *o* which, in the case of the *first resonance-globe*, produced a powerful effect, is now but of small moment.

We see with the aid of the resonance-globe that at certain points of the scale the harmonics of each individual vowel are specially powerful. Thus *o* sounds most effectively on or in the neighbourhood of *b'*, *a* in the region of *b''*, and so forth; putting it beyond doubt that there are sounds natural to and peculiar to the several vowels, and that, according to the particular vowel, there are certain fixed pitches in the volume of sound produced by the singer, which become specially prominent. Now a singer might not believe in these facts, and even doubt that these pitches are an essential

characteristic of the vowels; he might believe that they are something merely adventitious. Such doubts can be easily removed. The philosophical-instrument maker has connected with the Helmholtz resonance-globes an apparatus by which the existence of the harmonics may be made patent to an audience by ocular demonstration. This apparatus consists of eight resonance-globes, which are tuned to the series of the harmonics of the tonic *C*. At the back of each of these globes there is an aperture which communicates by means of an india-rubber tube with a little case closed by an elastic membrane. A gas-jet is placed close to this membrane, producing an easily agitated little flame. There are, accordingly, eight little flames corresponding to the eight resonance-globes. If now the air in one of these globes is made to vibrate, the vibrations are imparted to the corresponding little flame, whose vibrations again can be watched by means of a revolving mirror, moved by a crank. If now *C* be sung near this apparatus, this note will agitate the resonance-globes, and along with them the appertaining flames, and a glance at the mirror will suffice to show what the harmonics are. If, further, the different vowels be sung on *C*, the harmonics accompanying the tonic in varying degree for each vowel will be perceived as follows:—

a contains, besides the tonic, the 2d harmonic feebly, the 3d powerfully, the 4th feebly.

o has the tonic, the 2d harmonic very powerfully, the 3d and 4th feebly

e has the tonic feebly, the second harmonic rather powerfully, the 3d very feebly; on the other hand, the 4th very powerfully, and the 5th feebly.

u consists of the tonic, which is very powerful, and of the 3d harmonic, which is pretty well marked.

i has the high harmonics, especially the 5th, powerfully pronounced.

It is owing to the different shape the cavity of the mouth assumes for each of the vowels, that the differences here indicated arise. In order to convince one's self of the existence of the natural sounds of vowels, the following, certainly not very expensive, experiment may be tried. If one sounds powerfully before the open piano precisely that note which corresponds with the pitch of the instrument, the string of the piano corresponding with the note sung will be put into co-vibration, and will continue to sound independently even after the voice has ceased. On watching this phenomenon more closely, however, one perceives that the piano not only returns the note sung, but also the vowel sung on that note. On singing before the piano with the damper raised—that is, with the loud pedal pressed down—the vowels *a*, *o*, *e*, *i*, *u*, successively, we shall hear them echoed by the strings, and this more or less distinctly, according to the distinctness with which they are sung. From this experiment it is evident that it can only be the harmonics contained in the note sung that set the corresponding strings sounding; in other words, that the vowel-sound is only brought

about by the consonance of the higher strings answering to the harmonics of the note sounded. If the damper be not raised, but left resting on the strings, the experiment will fail.

It now remains to see of what practical advantage the Helmholtz vowel-theory is for the singer in the exercise of his art. Helmholtz says that female voices can produce all the vowels in full resonance on *b′*, whilst on the notes above *b′* the choice of vowels is more limited. As to male voices, he finds that the vowel *u*, whose characteristic note is *f*, is most easily sounded on *d*, *e*, *f*, and next to these on the *F* an octave lower. The vowel *e*, with its characteristic note *f′*, is best elicited on the higher bass notes *d′*, *e′*, *f′*, and next to these are the lower harmonics *f′*—viz., *f* and *B*.

According to Helmholtz, those vowels always tell best whose characteristic notes lie somewhat higher than the note sung; and next to these, those whose characteristic note is the 2d or 3d harmonic of the note sung. Helmholtz also points out the important fact that all female voices have an inclination, when singing notes below *c′*, to produce vowels verging on an "obscure" *o* or *ou*, the characteristic notes of which lie in that lower region. On the other hand, it is in the higher notes of the female voice, about *c″* and *f″*, that the vowel *a* tells best, because its characteristic tone lies near *b″*.

Every teacher of singing, and even every novice in the art, ought to study most carefully the vowel-theory

of Helmholtz, in order to understand how great an influence the harmonics exercise on *timbre*. Soft, sharp, trumpet-like, hollow, full, dull, and clear, and so on—all these shades of *timbre* arise only from various combinations of the harmonics.

Teachers have, in conducting the exercises of their pupils, to devote great care to the position of the mouth, and to call special attention to the varying of the *timbre*, because singing without proper colouring will always lack expression, and therefore effect. It is my conviction that faults in the formation of tone can be effectively removed only when the teacher himself is a thoroughly trained artist; for no theory on paper will impart to a pupil an artistically correct vowel *timbre*, or rid him of a false habit. In the same way, the teacher must show that for certain regions of the scale the clear *timbre*, for others, the obscure or semi-obscure, is the best. A soprano voice ought not to extend the clear *timbre* to notes beyond *f‴* sharp, and an alto not beyond *e‴*.

When an alto voice sings a clear open *a* on *e‴* flat, it will produce a disagreeable impression; while, on the other hand, the vowel *a*, taken more obscurely, will always have a pleasing effect. We can at any time convince ourselves of the correctness of this statement without any theoretical explanation. The theory of Helmholtz, however, enables us to prove by demonstration that we have to take these notes somewhat more obscurely, in order to make the vowel-

tone properly correspond with the note sung and its harmonics.

One need not know the vowel-theory in order to proceed, after all, in a manner similar to that of all the great artists of last century, who were guided by their natural sense of musical sound. Yet even those who do not possess this sense of beautiful sound, or in whom it is not yet sufficiently cultivated, will derive great advantage from the study of the vowel-theory, because they will be led by it to attend more closely to *timbre,* and, as a matter of course, to the position of the mouth, and they will find that the most satisfactory musical effect can be attained only by an exact agreement between the vowel-tone and the note sung.

Let the subject be closely studied under the guidance of an efficient master, let there be a determined will, and perseverance in repeated trials, and success will not fail; for much is gained from the outset if the mind knows what the ear ought to discover.

The management of the voice in starting the notes is also of great importance, for it greatly affects the *timbre.* We have noticed how in stringed instruments the *timbre* differs according as the strings, especially the low strings, are treated. Even in the piano, it depends greatly on the manner of touch whether a shrill, hard, or soft tone is produced. Much more does it depend on the management of the voice in starting the note, whether we are to hear a soft or a hard, a

shrill or a full rich tone. On this point we shall have to enlarge in the following pages.

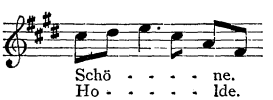
In exercising the voice, one must endeavour to find the most suitable vowels, or vowel-shades, for each individual note. The series of the harmonics for each individual note will be easily found by applying the sliding-table A to the key-board which is appended to this work, and as easily will it be seen what vowels occur in each series: thus, for instance, the one-stroked *c′* has for its harmonics *c″*, *g″*, *c‴*, *e‴*, and so on—and by these harmonics there are indicated as the most favourable vowels an *oo*, an obscure *o*, an open *o*, a medium clear *a* and *ä*; and similarly *e′* has the harmonics *e″*, *b″*, *e‴*, from which an open *o*, an obscure *a*, and *ä*, may be inferred to be favourable vowels. A medium clear *a* and *o* are very favourable vowels both for male and female voices, and the soprano must necessarily take the *a* throughout more clearly than the male voices can do; *ä* is a more favourable than *e*, because the two characteristic tones of *ä* lie closer to each other, and because the lower characteristic of *ä* lies also in a rather high region—that is to say, the two-stroked *d″*. *i* (ee), is a less favourable vowel than the others, more particularly so on account of its low characteristic, which has the same pitch as *u*—namely: The vowel *a* sung in a high key ought to be taken somewhat obscure by voices of every register; and in the same way, the *o* ought not to be taken

too close—that is, too much like *o* in most English words.

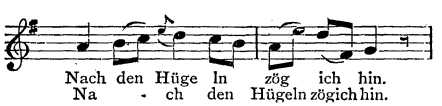
In most voices this close *o*, sung at a high pitch, sounds very strained, and very quickly fatigues the vocal organs. For this fact, also, we find an explanation in Helmholtz's theory, which shows that *b′* is the characteristic of the close *o*. This vowel must therefore be very convenient for singing up to that *b′*, and even somewhat beyond it; because, just on the notes from *d′* up to perhaps *d″*, the tonic, when sung on *o*, meets with a powerful resonance in the cavity of the mouth. Such is the case especially in female voices, which habitually treat this register softly; and also in male voices when they sing in *voix mixte* or falsetto. The object of male voices ascending the scale with chest-notes is to produce a higher degree of power, and this object cannot be attained without a vigorous consonance of harmonics. Thus to *d′* is required the vigorous consonance of *d″*, to *e′* that of *e″*, and so on; and this is possible only when the mouth is open for *d″*, *e″*, and so on—that is to say, for an open *o*. From this it is manifest that male voices, when they intend to sing with power from *b* or *c′* upwards, have to take the *o* more and more open the higher they ascend. The same is to be observed in female voices when singing an octave higher, from *b′* to *c″*, because here the tonic lies in the range of the open *o*.

It is not desirable, however, that one should be too pedantic in the treatment of the voice, for there are

always individual peculiarities which one must take into account. Thus, for instance, when Helmholtz's vowel theory says that *u*, sung by men, sounds best on *d*, *e*, *f*, it is not meant that one cannot sing it on *g*. Many vocalists sing *u* very distinctly on *g*; and it is only when taking *a* that the vowel somewhat approaches the *o*. In the same way they sing with ease *d′* and *e′* flat on *e*; still the high notes *e′* flat, *e′*, and *f′*, are sung with most ease on the open vowel *o*. I sing with great ease the high notes *e′* flat and *e′* on *ö*, as in that wonderful song of Schubert, "Sehnsucht," with Schiller's words, "Ach, aus dieses Thales Gründen," and so on, concluding with "In das *schöne* Wunderland." Yet the notes given to the syllable *schö* sound decidedly more rich and effective if I substitute for *schöne* the word *holde* with its pure *o*, thus—



For a bass voice the singing of *u* and *ü* on the high notes is exceedingly inconvenient. For instance—



Here the passage may be taken as modified in the lower line above. These and similar expedients may be resorted to in order to render a song with effect, and without straining the voice.

Helmholtz is of opinion that for the male voice the vowel *u* answers best to *d*, *e*, *f*; next to this to the *f* an

octave lower. I cannot quite agree with him on this last point, as I find that the low *f* sung on *u* sounds both very bad and feeble. Experiments on the vowels which I instituted at the Royal Court Opera in Buda-Pesth, in the presence of the Royal Intendant, Baron Podmanitzky, and some of the members of the Opera, show that on the low notes *f* and *e* an obscure *a* sounds richest and finest, and is, besides, heard at a far greater distance than any other vowel. To have ascertained this fact was of particular importance to myself, as there occur, as is well known, a number of these *f*'s in the part of Sarastro in Mozart's "Magic Flute,"—a part which was then assigned to me.

The teacher ought to endeavour to detect the peculiarities of every voice he has an opportunity of hearing, and thus to obtain a store of experience which he may bring into accord with the theory. If he is a thoughtful singer at all, he will not fail to derive much benefit to himself and to confer it on others by such a course. Leonardo da Vinci has said, "We must commence with practical experience, and by the means it supplies aspire to the discovery of truth." Experience is the interpreter of nature's wonders.

Before proceeding to the chapter on Formation of Tone, we shall first discuss the *Consonance* and *Mutual Relation* of *notes*, and with this bring the acoustic and musical portion to a conclusion.

It is owing to the peculiar intervals existing between harmonic and tonic that only those notes are consonant

with one another which lie at definite intervals from each other. When several notes are simultaneously sounded, they either awake in us a feeling of discomfort, if they are dissonant, or they call forth pleasure by their harmonious concord. Now it appears that only those simultaneously sounding notes give us the pleasant sensation of harmony, the vibration-numbers of which stand to each other in perfectly definite proportions, which can be expressed without the use of fractions by whole numbers of small value.

C and *c* sharp sounded together produce on our ear the disagreeable effect of a dissonance; *C* and *E*, on the other hand, are harmonious. As said above, only those simultaneously sounding notes, the proportion of whose vibration-numbers can be expressed by whole numbers without the use of fractions, produce the pleasing sense of harmony. Thus the vibration-numbers of tonic and octave are in the proportion of 1 : 2, those of tonic and dominant of 2 : 3, and those of tonic and minor third of 5 : 6; further, those of tonic and minor sixth in the proportion of 5 : 8, and those of tonic and major sixth of 6 : 10 or 3 : 5. These seven intervals here named have this characteristic, that each of them produces on our ear a pleasing effect, and they are therefore called consonant intervals.

When two notes are sounded in succession, either the harmonics of the one are altogether different from those of the other, or individual harmonics of the one coincide with individual harmonics of the other.

If two notes sounded one after the other have not even one harmonic in common, it is immediately perceived that they are utterly strange to each other. Notes having harmonics in common appear to the ear related to each other, even though a previous resolution into harmonics has not taken place. Thus, for instance, we at once perceive that the notes *C* and *E* have constituent elements in common. We say that notes having harmonics in common are related to each other, because of their close harmonious connection.

Notes coinciding in the largest number of harmonics, and in the most powerful harmonics, have the closest relation to each other; and this relation is most pronounced in the notes having a 3d and 4th harmonic coincident. Now this is actually the case in all the *timbres* available for musical purposes. A lesser degree of relationship is exhibited by those notes whose coinciding harmonics are of a high pitch, and generally very feeble; and it is to be noticed here that the musically available *timbres* have this in common, that the higher harmonics are feebler than the lower ones. If, accordingly, we arrange the notes related to any particular tonic, we find, starting from the fundamental tone, the following progression: octave, double octave, fifth, diatonic twelfth, fourth, major third, minor third, major sixth, diminished seventh.[1] By applying the sliding-tables A and B to the key-board

[1] The above suffers very slight modifications owing to the differences between true and tempered pitch.

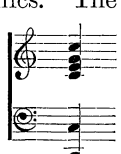
(see Appendix and Directions), all notes related to each other, and the degrees of their relation, may be easily ascertained.[1] The proportions of the intervals between tonics and harmonics are invariably the same. If the reader wishes to ascertain the degree of relation of two notes, he may, with the aid of the sliding-table B, trace their agreement with the most numerous and most powerful harmonics in Table A. In Table A the harmonics of *C* are indicated. If we push the slide B farther on, as, for instance, to *C* sharp, we immediately see that *C* and *C* sharp have no harmonics in common: these notes, therefore, are not related to each other. Passing the slide farther on to *D*, we find *C* and *D* likewise not related; advancing with the slide to *E* flat, we observe that *C* and *E* flat have harmonics in common, but that these are both high and feeble; therefore *C* and *E* flat are related to each other, though only in a slight degree. Farther on, we find *C* and *F* related, as the harmonics 3, 6, 8, coincide with each other. *C* and *G* are more closely related, because they coincide in the more powerful harmonics—namely, 2, 4, 6. The strongest degree of relationship at last exists between *C* and *C'*, because they coincide on 2, 3, 4.

In the manner here stated, the relation of all notes

[1] The idea of using the model key-board for finding the partial tones was put forward by Professor E. Mach in the östr. Gymnasial-Zeitschrift in 1864. I have modified and enlarged the model, and through these alterations, people who do not know the key-board will understand how to use the model. The sliding-table B may be conveniently used as a book-mark.

to *C* can be ascertained, and, in a similar way, their relation to any other tonic. Let us then repeat, the relation of notes depends on the coinciding of their harmonics. Notes related to each other are suited for harmonious combination, and yield pleasing chords. Notes not related to each other form dissonances, and affect the ear unpleasantly. The pleasing impression made by a consonance mainly depends on the *timbre* of the harmonics, and we may say that notes simultaneously sounded, and forming a clearly comprehensible combination, constitute musical chords or harmonics. The combination may be more or less intimate. The simultaneous sounding of notes in an intimate combination with each other is called accord. The most perfect chord is formed by the combination of the nearest and most natural harmonics:—

Proceeding from this, the chords and harmonics are developed by the mutual relation of notes. We see, then, that the laws of *timbre* form the basis of harmony, and harmony is the more perfect the more the tonic is intensified by its manifold harmonics. The perfect chord consists of tonic, third, fifth, and octave; and in order to make its effect the more agreeable, the two lower octaves of the tonics must be added. These, indeed, produce nothing new; they only intensify the tonic.



It will strike the reader that the tonic is represented four times by its higher and lower octaves, whilst the third and the fifth occur but once; but he must understand that in a perfect chord the whole of its notes must be looked upon as simply an intensification of the tonic, —in other words, the perfect chord is one single musical note of rich and manifold *timbre*.

We would recommend the pupil to commit to memory the following: By altering the position of the mouth, we can blend with each other in various degrees of strength the tonic and its harmonics in the voice, and to the variety of the combinations thus effected the variety in the sounds of the vowels is to be ascribed.

The mouth can, through alterations in its shape, be constrained to produce a resonance either for the tonic, given out by the vocal chords, or for any of its harmonics.

The *timbre* of the voice is altered by the intensification of particular notes by means of the resonance of the mouth.

We can distinguish the sound of one vowel from that of another, although both sounds have the same pitch and force.

It is the peculiarity of the vowel-sounds that the intensified harmonics have an invariable and absolute pitch, whilst the pitch of the tonic may change.

PHYSIOLOGY AND ANATOMY OF THE VOICE

PHYSIOLOGY AND ANATOMY OF THE VOICE.

THE VOICE.

THE human organ of voice is one of the most sensitive, complicated, and complete of musical instruments. It is composed of a breathing apparatus, of a sounding apparatus, and a resonating apparatus: and it is only through the properly co-ordinated action of these several parts that a good tone can be produced.

The lungs are the breathing apparatus, and they act like the bellows of an organ. They are spongy elastic masses on each side of the cavity of the thorax, connected above by the branches of the windpipe, and they rest on the diaphragm. The right lung is divided into three, the left into two lobes, which are again subdivided into lobules, and these are still farther subdivided into very numerous air-cells. The special function of the lungs is the process of inspiration and expiration: these are respectively carried out by the widening and heighten-

ing of the chest-walls, or by the narrowing of the cavity which they contain. The principal utility of this process consists in the transformation of dark venous blood into red arterial blood fit for the nourishment of the organism. Venous blood contains carbonic acid derived from the combustion and waste of the tissues: when this venous blood comes to the lungs, it gives up the carbonic acid, and takes up in its place a certain quantity of oxygen from the air with which the lungs have been filled. An idea of the action of the lungs may be obtained by the following simple means: The lung of a pig or a calf can be easily procured. If we take such a lung, and into the windpipe insert a piece of india-rubber tubing, we may easily inflate the lung by means of bellows. The lung then assumes a considerable size, and contains a large volume of air. If the india-rubber tube be squeezed so that no air can escape, the lung remains dilated and at rest; but if we allow air to escape by relaxing our pressure on the india-rubber tube, the lung will return to its original form and dimension, thus producing an outward current of air through the india-rubber tube. This presents us with an image of what happens within our own thorax at each inspiration when we take a full breath, and then, as the saying is, hold our breath. The result is the same as that obtained by squeezing the india-rubber tube, and thus preventing air from escaping from the lung operated upon as above. A pair of bellows presents the same kind of action—alternate inflow and outflow of air.

The diaphragm, which forms the floor of the cavity of the thorax and the roof of the abdominal cavity, plays an important part in inspiration, for it aids largely in expanding the thoracic cavity within which the lungs play.

In its relaxed state the diaphragm arches, like a balloon, upwards into the cavity of the chest, against the inner walls of which its marginal portions then lie. By its contractions the convexity of the diaphragm is reduced, it becomes flat, its edges detach themselves from the sides of the cavity of the chest, and the additional space thus gained within the latter is immediately occupied by the lungs. By the depression of the diaphragm, accordingly, an expansion of the cavity of the chest is produced, owing to which condition the lungs can with ease receive a larger quantity of air.

Expiration usually follows immediately upon the ceasing of an inspiration. When singing, of course, one must more or less retain the air, according as the nature of the composition demands a more or less sustained breathing, and must allow it only gradually to escape. Then the distended ribs resume their natural position; the diaphragm moves upward, and by reoccupying its former position, lessens the cavity of the chest; the lungs collapse, and a certain quantity of air issuing from the pulmonary cells finds its exit by means of the windpipe, through the cavities of the mouth and nose.

The windpipe occupies the front part of the throat, and the gullet or œsophagus is situated behind it. The

windpipe is a tube consisting of cartilaginous rings and a membranous lining, and is divided at its lower portion into two branches (the bronchi), one of which enters the right and the other the left lung. These bronchial branches are again divided into many smaller channels, which serve as air-passages. The windpipe is an exceedingly elastic structure, owing to the capability of the cartilaginous rings of being pushed closer to or drawn farther apart from each other—the former movement shortening, the latter lengthening the windpipe.

At its upper end the windpipe joins the larynx, which, as a musical instrument, is peculiar to man. It is in the larynx that, with the aid of the air streaming forth from the lungs, the tone is first formed, whereupon it receives in the faucial cavity, and in that of the mouth, that intensity and colouring or *timbre* which make the tone a musical note.

There are in the larynx two very elastic ligaments stretched horizontally from front to back, "the vocal chords," which, according as the glottis, the chink between them, is closed or opened, approach or separate from each other. When we breathe freely, the vocal chords recede widely from each other, in order to allow the air to pass through. If, however, we wish to speak, or to sing, or to produce any kind of sound, the vocal chords must draw together so as to close up, and to be put into sounding vibrations by the air impelled against them by the lungs.

The larynx is composed of the following five carti-

lages: 1st, the cricoid cartilage or ring cartilage (the base cartilage); 2d, the shield or thyroid cartilage (the cartilage stretching the chords); 3d, arytenoid or ewer cartilage; 4th and 5th, the two Santorine cartilages (*cartilagines Santorinianæ.*)

The cricoid cartilage derives its name from the resemblance its shape bears to that of a signet-ring: the portion lying towards the back of the throat is much higher than the front portion, and the lower edge of the ring is connected with the uppermost ring of the windpipe by a short circular ligament.

The thyroid cartilage rests on the cricoid cartilage. It consists of two almost four-cornered cartilaginous plates, having the shape of a shield. The upper and lower edges are convex, so that they form an upper and a lower indentation where they meet.

The two arytenoid cartilages (also called regulating cartilages) have the shape of oblique trilateral pyramids, and attached to the obtuse points of these by a small capsular ligament and joint are the two cartilages of Santorini, named after Dr Santorini, who first recognised them as independent structures. All these cartilages are connected with each other by muscles, by means of which they can be brought nearer to or removed from each other. Besides these, there exist a number of other muscles, by which the larynx is raised or lowered as a whole in the throat. Within the larynx there are two pairs of elastic membranous ligaments or bands, both of which pairs are attached by

their anterior ends to the thyroid, and by their posterior ends to the arytenoid cartilages, the left band of each pair to the left, and the right band to the right cartilages.

The two lower or true vocal chords lie, raised a little towards the front, opposite each other on a level, so as to leave between them a narrow slit—namely, the glottis. The lower or true vocal chords, according to the opinion of most physiologists, play the principal part in the production of sound. The upper or false vocal chords are also called pocket-ligaments, because there lies between them and the true vocal chords a pocket-like cavity, the lateral parts of which are called the laryngeal or Morgagni pockets. According to Professor Reclam, they serve the purpose of checking the vibrations of the air, which tend to spread in a lateral direction in such a manner that only the central straight current can reach the cavities of the mouth: other physiologists think that they render the tone softer. Others again, — as, for instance, Brunns and Professor Störck—the latter gentleman a distinguished musician,—maintain that the pocket-ligaments are by no means quite unconcerned in the production of sound, seeing that they can occasionally act as substitutes in the case of certain forms of disease of the true vocal chords.

In the false vocal chord, Rüdinger found a peculiar muscle, the pocket-ligament muscle, or muscle of the false vocal chord,—musculus ary—epiglotticus inferior.

Rüdinger ascribes to it the power of altering the position of the Morgagni pockets, which are hollows lying between the false and the true vocal chords, and, accordingly, of exercising an influence on the action of the resonating space within the larynx. He stimulated the muscle of the pocket-ligament in the larynx of a man who had been executed, and found that by means of this muscle the pocket-ligaments are enabled to execute independent motions, both inwards and downwards, through which motions the entrance to the Morgagni ventricle is narrowed, while the pocket itself is widened by the recession of the medial from the lateral wall.

The pocket-ligaments, moreover, are of importance as a protecting apparatus, as, owing to their great irritability, they are always ready to ward off injurious objects from the true vocal chords, by quickly approaching each other like the eyelids.

Physiologists have expressed various opinions as to the functions of these laryngeal pockets, and it is especially held that they are to be considered as important resonating chambers. Fabricius compared their action to that of the membranous pouches protruding from the sides of the throats of certain species of frogs when they croak. J. Morgagni asserted that these pockets (named after him) are contracted when a high note is to be produced, but that they expand again when low notes are sounded. "It is certain, at any rate," says Professor Luschka, "that these pockets materially contribute to the isola-

tion of the vocal chords, allowing them the greatest possible freedom of vibration; and besides, they afford the column of air that has been set sounding, space for lateral expansion." But the vocal chords are, besides, useful in a way that must not be undervalued: the mucus secreted in them is always at hand to spread over the vocal chords, which, on their part, are devoid of mucous glands, and are only thus kept sufficiently moist. With dry vocal chords, only dry hard notes, never soft and liquid ones, can be produced. If in singing the action of the vocal chords is kept under proper control, and is rationally moderated and increased, it will of itself attract the requisite moisture by the stimulus it imparts to the vital functions in general. It is of particular importance that singing should not be continued for too long a time without an occasional pause for rest.

Dryness of the cavities of the mouth and of the vocal chords will also be prevented by breathing as much as possible through the nose. As regard ring and purity of tone, these qualities depend mainly on the condition of the mucous membrane of the cavities of the mouth and of the vocal chords. Everything that tends to make these membranes thicker, drier, harder, or moister than is necessary, injures the ring of the voice. Klenke even avers that too great dryness of the cavity of the mouth frequently becomes the cause of stammering, which may be easily explained by the fact that dryness impedes the movements of the tongue

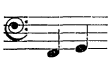
and lips. The true vocal chords are, in their normal condition, pale, and of a white, mother-of-pearl-like hue, while the pocket-ligaments always appear beautifully red. The true vocal chords also become red on excessive exertion, or through cold.

The lid of the larynx, the epiglottis, protects the respiratory and vocal organs from the intrusion of particles of food and drink. The epiglottis is an elastic, cartilaginous plate, somewhat broader at its upper surface than at its lower, and fastened with its roots on either side in the angles of the thyroid cartilages above the upper ligaments. The epiglottis is, besides, connected with the bone of the tongue (the hyoid bone), so that every motion of the tongue causes immediately a corresponding motion of the epiglottis. As soon as the epiglottis is touched by portions of food, it falls back and closes the access to the larynx, so that the food, passing over the epiglottis, reaches the gullet or œsophagus.

When a tone is to be produced, the muscular apparatus of the larynx is put into motion to narrow the slit of the glottis, and to stretch the vocal chords to a greater or less degree, according to the particular height of the tone to be produced. The muscles serving for the purpose of stretching the vocal chords are the crico-thyroid muscles. The function of these muscles lies in their power of drawing down the thyroid cartilage towards the cricoid, so that the former is sometimes nearer, sometimes further, from the latter. When those

two muscles connecting the thyroid with the cricoid cartilages lie at full length, as is the case in their ordinary state of rest, the thyroid cartilage stands at its greatest distance from the cricoid, and accordingly the vocal chords have the least tension. It is in this position of the organ that the lowest notes are obtained. But when the two muscles mentioned are fully contracted and in a state of intense condensation, the thyroid most closely approaches the cricoid, and the vocal chords have the greatest tension, and we now have the highest tones of the voice. Observations made both on living subjects and on excised larynges show that the voice is formed in the glottis. If, in consequence of some accident or surgical operation, there is an opening in the windpipe of a person, the voice is lost; but it may be restored by closing the opening. On the other hand, an opening produced above the glottis does not entirely annihilate voice: the epiglottis, and even the upper vocal chords, may be awanting, and yet there will be voice. If the glottis of living animals be laid open, it is easy to demonstrate that the lower vocal chords which enclose the glottis are set vibrating when a tone is being uttered. The discovery of the laryngoscope has enabled us to watch the vocal chords in the interior of the organism in its normal state, while they are in action. It must be understood, however, that these observations can be made only on the vowel *ä;* because when the other vowels, *a* (ah), *o*, *u* (oo), are being sounded, the epiglottis

overhangs the larynx, so that the vocal chords cannot be seen. When sounding *i* (ee) and *e* (eigh), again, it is the tongue that obstructs the view of the larynx. It would seem as if the tongue and epiglottis wished us not to learn all the secrets of the vocal apparatus, and as if they endeavoured thus to confine us to mere hypotheses, continually new.

Yet we distinctly perceive that, when *ä* is being sounded, the vocal chords perform vibrations in producing sound, and that these vibrations differ in intensity according to the different pitch of the tone. Especially when singing deep chest-notes, such as *f*, *g*,  the vibrations are very wide, so that as often as the vocal chords are turned inwards, the glottis is entirely closed,—a fact which I have repeatedly observed.

When examining the larynx by means of the laryngoscope, we see, in the first place, the back of the tongue, next to it the ligament of the tongue and epiglottis, then the edge of the epiglottis, the two pocket-ligaments right and left, the slit of the Morgagni laryngeal pockets, and between these the true vocal chords. These are kept at some distance from each other by the two arytenoid cartilages, the little heads of which are visible, and it is the open space thus produced between the chords that is called the glottis. Through it the windpipe is seen at the point where it divides into the right and left bronchi.

Simple as is the manipulation of the laryngoscope,

any novice who wishes to make laryngoscopic observations should at first only endeavour to do so under the guidance of a physician who has made the larynx his specialty. When a note is sounded on the *ä*, as described above, the little heads of the arytenoid cartilages, with the farther ends of the vocal chords, are seen to move somewhat forward away from the wall of the gullet, and closer to each other; and we observe a chink like a line, and in it a trembling motion, which endures as long as the note lasts. This chink is the closed glottis. From it the tone proceeds. We have seen that the arytenoid or regulating cartilages play an important part. They approach one another, and bring the two vocal chords, which, in a state of rest, are far apart, into close proximity.

For the production of a powerful and yet soft note, it is necessary that the vocal chords, at the moment when they approach one another, should place themselves side by side in straight lines, so close to each other as to completely close the glottis for the time. When the edges of the vocal chords are rough or graze each other, and thus but imperfectly close the slit during the vibrations, a rough voice is produced. If we possess healthy and well-formed vocal chords, a knowledge of the formation of tone, and a good musical ear, we shall be able to sound each note of the scale with precision and purity.

The exactness with which a trained human voice intones musical notes is truly wonderful when we con-

sider what nicety in the graduation of muscular tension is necessary, and how this accurate graduation solely depends on our sense of the correctness of the note—that is, on memory—for the position of the muscles requisite for the note in question. A. Klüger graphically noted the vibrations of two membranes—the one of which was set vibrating by a note of the human voice, and the other by one from the pipe of an organ. He found by these comparative experiments that the average deficiency of a well-trained voice in intoning the note amounted to no more than 0.357 per cent; therefore, for 100 vibrations in the second between *G* and *A* of the great octave, the error amounted only to about $\frac{1}{3}$ of a vibration more or less, and is therefore unrecognisable by the best musical ear. A well-practised muscle of the larynx can, according to the perfection of its musical training, manage from 40 to 150 different degrees of tension in producing the various notes.

The organs surrounding the glottis exercise by their resonance an influence on the sounding power of the note. In the so-called chest-notes, the resonance of the chest predominates; in the falsetto notes, it is rather the organs of the cavities of the mouth and nose that vibrate. The powerful notes of the human voice we call chest-voice or natural voice; the softer notes we call falsetto or artificially produced voice.

In the chest-voice—that is, in the natural way of producing sound—the vocal chords are somewhat relaxed, and vibrate in their entire length and body,

while the glottis is narrowed, and the air passing through it compressed. Then, a strong resonance of the chest-walls being brought into play, a powerful and sonorous note is produced. In chest-notes the larynx is somewhat drawn down—the muscles underneath it are in a state of tension; in falsetto notes, on the other hand, the muscles underneath the larynx are relaxed, the larynx rises somewhat, the vocal chords are more stretched and leave a broader slit between them, the air passes more gently through the glottis, and the vocal chords are only in partial vibration—that is, only their inner edges are active. Owing to the great elasticity of the vocal chords, they remain smooth and without folds even in that state of relaxation which, to a greater or less degree, they present during the production of chest-notes.

The transition from chest-notes sung with moderate exertion to the falsetto, which is effected with the aid of a larger number of muscles and at a greater expense of breath, is difficult for the beginner, because in this transition the larynx has to alter its position, and the upper muscles have to assume a more prominent activity, and to relieve the lower ones, which have slowly to relax—an operation always more difficult than a gradual increase of tension. By singing chest-notes very softly, however, the transition to the falsetto is rendered comparatively easy, and specially so when the notes are sung on the vowels *u*, *i*, *ü*.

One can distinctly feel the alteration of the position

of the larynx by placing the finger gently on it, whilst gradually passing from a high chest-note to a falsetto note: on the sounding of the latter the larynx rises slightly. In the same way one can observe the alteration in the vibrations of the chords by placing gently two fingers on the lower two-thirds of the thyroid cartilage, for this is the place where the vocal chords lie. During the singing of chest-notes we shall feel the vibrations more strongly than we can in the falsetto.

The *voix mixte* is a register composed of chest and falsetto voice: in using it in singing, the whole of the notes must be sung in *chiaro-oscuro*. It differs from the chest-voice in this respect, that it does not depend on the tension of the vocal chords alone, but permits a so-called "compensation" to take place, by which the tension of the chords is lessened, while the volume of air is increased.[1]

We have already learned that tone is the result of a certain tension of the vocal chords and of the breath pressing against them; we likewise know that a given degree of tension demands a certain volume of breath. The tension of the chords increases with the higher pitch of the note, and consequently the volume of breath must be increased in proportion. These two factors — tension and volume of breath — therefore, stand in perfectly definite relations to each other in the

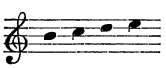
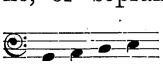
[1] The subject of *voix mixte* is entered into more fully in 'Musical Education and Vocal Culture,' p. 93.

production of one and the same note. The slightest variation in the degree of tension must, if the note is to continue sounding at the pitch given, require a corresponding variation in the volume of breath. We thus see that a note may be sustained at its pitch, even with a relaxation of the tension, by increasing the volume of breath and imparting to it more energy, or *vice versâ* with a lessening of the volume of breath by increasing the tension. This supplying on the one hand what is taken away on the other is called "compensation."

Any note, accordingly, may be obtained in two different ways—either with a strong muscular tension and diminished breath, or with diminished tension and a plentiful current of air from the lungs. The latter method is the one best calculated for the production of chest-notes, and recourse to it is all the more necessary when they must be sung with force; while falsetto notes require the mode first mentioned, particularly when they are to be taken softly. This explains why chest-notes verging on piano are merged into the falsetto, and falsetto notes verging on forte pass into the chest-register.

If we wish to impart to falsetto notes a greater fulness, so as to make them resemble chest-notes, we must find the necessary position of the mouth and the proper volume of breath; and a position of the mouth by which its cavity is arched as much as possible will give such notes the desired resonance. We must know

how to bring into play the resonance of the cavity of the mouth, a subject of which we have already treated in the chapter on Acoustics. By suitable management of the breath we can also extend the vibrations of the edges of the vocal chords in falsetto singing to the thicker parts of the chord: by this the tone is likewise made more powerful, and more like that of chest-notes. The singer must, in so doing, always make beauty of sound his constant consideration, and avoid all straining and forcing of the voice, else the note will not remain true.

The part of the scale at which the registers divide—or, more properly, at which the character of the tone perceptibly changes—usually lies in female voices on the following notes,  according as the voice is alto, contralto, mezzo-soprano, or soprano. In male voices the break lies on  according as they are deep bass, bass, baritone, or tenor.

The female larynx is smaller and more delicate, but at the same time more flexible, than the larynx in men: on the average it is about a third less than the male larynx. The vocal chords are smaller—their length bears the proportion of 2:3 to that in men—and therefore female voices have a higher pitch than male voices; and owing to the greater flexibility of the vocal organs in women, we often hear ladies execute shakes and the most difficult florid passages, while we very rarely hear male voices perform in a similar style. As a matter

of course, male singers may surprise us by brilliant execution, if they apply themselves with diligence and correctness to their studies. We need only mention Fischer, Lablache, and Tamburini.

The larynx in boys greatly resembles that in women, whence boys' voices have a similar compass to that of women.

Of special importance for singing are, next to the ear—the supreme judge and best guide in the art—the tongue-bone, the tongue, the faucial cavity, with the palate and uvula, and the teeth. We shall later on discuss the ear in greater detail.

The tongue-bone stands in immediate connection with the larynx; its position and movements, therefore, exercise a great influence on the formation of tone. The tongue-bone resembles in shape a horse-shoe. According to Reclam, it originally consists of five separate parts, which in infancy are joined to each other with a certain freedom of motion, but which grow into one solid body when the years of maturity are reached.

The tongue, owing to its power of movement, which it derives from a wonderfully woven tissue of multifariously divided muscular fibres, plays an important part in the human organism. Not merely the animal function of gustation, but also the highest of all human muscular activities—namely, speech—depends upon the tongue.

The tongue is fixed between the chin and the tongue-bone; it can be lengthened and flattened, rolled up, and

turned in every direction; it can be made broader, shorter, more pointed, narrower, and thicker; we can execute with it every acrobatic feat: we can move it as the elephant can move its trunk.

The position of the tongue promotes or mars the formation of tone. From root to point it is capable of impeding the tone, and of making it diverge from its proper path. Most faults in singing the guttural, the palatal, and the nasal tone, have their origin in a faulty position of the tongue. Since, however, the tongue and the lower jaw are parts of the organism, which to some extent lie under our control, the singer is in a position to effect improvements; and this is best done if he makes his observations before a looking-glass, and listens attentively while producing his notes.

In front of the uvula, the soft palate or *velum palati* has two arch-like folds, and between these two arches there lie on the right and left sides the tonsils. If these are too strongly developed they tend to produce a palatal tone, and if this is the case, they may be operated upon without danger; yet one must not be too rash in using the knife, for frequently their bulkiness is but a temporary swelling, and we must not forget that Nature has not created any superfluous thing. To the tonsils fall the task of secreting, during the act of swallowing, a viscous mucus in which the passing morsel is enveloped. They also convey moisture to the vocal organ when it is used in singing. This is the reason why we sometimes find our-

selves compelled to make movements such as are required in swallowing, whenever, in consequence of protracted speaking or singing, a part of the palate has become parched.

During the formation of tone the soft palate and the uvula must be raised, in order to ensure beauty of tone.

The teeth, on their part, have the function of imparting to the tone a metallic ring, and must therefore be perfect in singers; defects must be attended to by the dentist.

The hard palate is the vault—the resounding roof—struck by the sounding current of air; and the higher and the more vaulted this roof is, the fuller and richer will be the tone produced when the breath is properly managed.

THE EAR.

One of the most precious gifts of heaven is a good ear. If we have lost hearing, we have taken farewell of living humanity as existing in song; the characteristic charm of music is for us at an end. The senses of touch, smell, and taste would then still sustain us, but the passionate, tender, and loving appeal of music to the human soul is lost to us for ever with all its attendant grandeur, beauty, and dignity.

The sense of hearing is to be looked upon as at once the reflexive source and the regulating agent of audible speech, and of the formation of tone. It is the best

singing-master and the best critic. Deaf people, when properly instructed, may, it is true, form words, but they can never sing; their speech is always rough and unsympathetic, it has no musical substance or cadence. When deaf mutes wish to communicate with speaking persons, they must divine with the eyes from the movements of the lips and features the words spoken. It is only under the sway of the ear that we attain to refinement and smoothness of articulation, and to euphonic speech.

Human speech or language is transmitted from generation to generation only by means of constant repetition of the act of hearing, and by imitation of that which is heard; and Romulus and Remus, if left to the tutorship of the she-wolf that nursed them, would, no doubt, have learned excellently to howl with the wolves, but never to speak Latin with the Romans. Babes whose badly articulated combinations of sounds are intelligible only to the mother, the nurse, and people in the house, only babble, they do not speak. If persons are foolish enough to imitate this babbling, and to converse with the little creature in equally defective sounds and words, the child will even in after-years be found to retain its lingual imperfections, and to be afflicted with a style of speaking little becoming to the adult. The child's ear as readily adapts itself to the good as to the bad, and therefore the child should always be taught to speak with perfect accuracy of tone and articulation.

Directing our attention to the anatomical construction of the ear, we first have to observe that it is the function of the organ of hearing to receive and to convey to our consciousness the waves of sound, and that this organ consists of three different parts,—namely, the external ear; the apparatus situated next to it, which we may call the middle ear; and the portion situated within the skull itself, the internal ear. The external ear serves for the reception of the waves of sound; the middle ear conveys these waves through a set of apparatus on to the internal ear, where they meet with certain sensitive cells, and are transmitted to the auditory nerves, which ultimately conduct them to the brain.

The external ear consists of the shell of the ear and the external auditory meatus or ear-passage. It concentrates the waves traversing the air, so as to intensify the impression they make. If the shell of the ear is wanting, or if it is too much flattened, the acuteness of hearing becomes impaired.

Professor von Tröltsch, however, maintains that the loss of the shell of the ear has no perceptible effect in man; yet we can easily observe that the distinctness of hearing is considerably increased by artificially enlarging the shell of the ear by applying to it the hollow of the hand.

The middle ear is separated from the external ear by the tympanic membrane or drum of the ear, which receives vibrations from the outer air, takes them

up, and transmits them to the middle ear. The drum of the ear possesses a muscular apparatus, by which it can be subjected to greater or less tension: this varying tension seems to be required in order to adapt the tympanum to the reception of different sounds.

There is often a knock at the tympanic membrane: if the visitors are true and respectable—I mean, if they are true notes—they are to be kindly received; but one should close the ear against improper comers, which should be kept out as much as possible. Musical people ought to guard carefully against the exposure of the tympanum to violent and sudden impressions.

There are three minute bones in the intermediate ear, of which the one nearest to the tympanum adheres firmly to that membrane. It is called the hammer, or *malleus;* and by the position of that bone, the transmission of the sound-waves striking the tympanic membrane to the apparatus within the internal ear is effected.

We may fully inspect the tympanic membrane through the external ear, by means of small funnels or specula, and by means of a small mirror called the otoscope. We then see it present itself as a shining lightly stretched membrane, on which a delicate ledge may be distinguished, extending from the upper margin towards the centre, where it ends with a small button-shaped projection. This ledge is part of, and indicates, the position of one of the three bones of the ear men-

tioned above—namely, the *malleus*. These minute bones differ in shape, and they form, so to speak, a bridge between the drum of the ear and the portion of the auditory organs lying within the skull. The three bones are named, from their forms, the hammer or *malleus*, the anvil or *incus*, and the stirrup or *stapes*. According to the opinion of some investigators, these little bones serve also to break or to modify the action of excessive vibrations of the tympanum on the organs of the internal ear.

The hammer is that bone which abuts directly on the tympanic membrane: its head is in contact with the anvil; and adjacent to the anvil lies the third little bone, the stirrup or *stapes*. The broad and flat portion of the *stapes* at its inner end fits into an aperture which leads to the internal ear, and thus connects this portion with the drum of the ear. The three little bones are connected with each other by intermediate tissues, the so-called ligaments, and there are similar ligaments connecting them also with the walls of the tympanic cavity. This cavity is filled with air, and its walls have a slight covering of mucus. In a diseased state the place of the air is sometimes occupied by a watery fluid, or even by pus. From the tympanic cavity an air-tube, called the ear-trumpet or Eustachian tube, leads to the cavity of the throat and nose. This air-tube takes its name from the Italian anatomist B. Eustachius, who first gave an accurate description of it in the sixteenth century. It is opened during every act of

swallowing, and it serves for the renewing and tempering of the air enclosed in the cavity of the tympanum. On imitating the motion of swallowing, we may hear the air distinctly striking the drum of the ear, which closes the tympanic cavity towards the exterior.

The tympanic cavity is separated from the third and last portion of the ear—the, so to speak, *sanctum sanctorum*—by a long tissue, in which there are two window-like little apertures; one of them circular, and called the *fenestra rotunda*, or round window—the other oval, the *fenestra ovalis*, or oval window. These windows are closed by membranes.

We have seen that the little bones are arranged in a line across the cavity of the tympanum, that they are connected with each other, and that the oval little plate of the *stapes* is fastened to the membrane of that little oval aperture which is called the oval window.

The internal ear consists of a series of connected portions, exhibiting a peculiar structure, and designated, on account of their intricate construction, the labyrinth and the cochlea. We find here a number of channels, and distinguish among these the vestibule, several semicircular canals, the cochlea (or snail's shell), and the so-called aqueducts. All these parts, communicating with each other, lie within a strong mass of bone.

The labyrinth is filled with aqueous lymph, and contains very delicate membranous structures, against which are extended the terminal ramifications of the auditory nerve. The vibrations of the air which set the

tympanum and little bones in motion are imparted to this aqueous lymph, and conducted by it to the auditory nerve. Seeing that the aqueous lymph in the labyrinth is enclosed on both sides by membranes forming yielding partitions, it will be understood that the aqueous lymph itself is capable of an oscillating motion, simply because its membranous walls can obey the vibrating impulse. The importance of the aqueous lymph is apparent from the fact that its escape, through an injury done to the labyrinth, inevitably results in deafness. At a certain spot of the labyrinth there grow among the terminal fibres of the auditory nerve a number of extremely delicate elastic hairs, which end in very sharp points. These delicate hairs, which were discovered by Max Schulze, are supposed to be fitted in an extraordinary degree to take part in those vibrations of the aqueous lymph which answer to their own vibration-periods. Excited to vibration in this way, these delicate hairs affect the nerve-fibres situated among their roots, and thus produce the sensation of hearing. By way of analogy, we may mention that Dr Hensen instituted most interesting microscopic experiments with similar hairs in the crayfish, in which they are exposed to view on the external surface of the shell. These animals are extremely sensitive to every sound, and as the hairs were closely watched, it visibly appeared that these hairs were set into strong vibration when powerful sounds were conveyed to them, and that the auditory nerve oscillated in consequence.

It further appeared that different hairs were specially susceptible to different sounds.

In another part of the labyrinth we find a number of minute crystalline particles, called the otoliths, deposited among the nerve-fibres. These otoliths seem, when influenced by vibrations, to exercise an intermittent pressure on the adjacent nerve-fibres, and in this manner to affect the brain. These otoliths are, according to the opinion of some physiologists, especially adapted by their weight to prolong the vibrations of sounds of an evanescent nature, which might otherwise, perhaps, remain unobserved.

Again, in another part of the labyrinth, the so-called cochlea, the Italian Marchese Corti recently discovered, by means of the microscope, an organ—the organ of Corti—in which there are to be found a series of arched structures, the so-called Corti rods. This organ of Corti also contains several thousands of cells lying upon the arches, and of these about 33 are counted for each semitone. These arches are of different lengths and of different degrees of elasticity; they are supposed to be similar to the strings of a piano, adapted to different pitches, and communicate with different nerve-fibres, so that when these arches are set in vibration, they transmit their vibrations through the corresponding sensitive nerve-cells, and to definite portions of the nerve-fibres. This Corti organ might be said to form an internal piano, playing all the notes received from without. Physiologists, however, are not yet decided as to the manner in

which the vibrations in the organ of Corti take place. Helmholtz ('Die Lehre von den Tonempfindungen,' 3d edition, p. 218) says that the organ of Corti is an apparatus calculated to receive the vibrations of the basilar membrane, one of the membranous partitions bounding the aqueous lymph, and thereby to be itself set in corresponding vibration. The whole arrangement leaves no doubt as to this fact; but in the present state of our knowledge, we cannot yet determine in what manner these vibrations actually take place.

We may assume that the vibrations of a note are transmitted to our brain by the vibrations of the nerve-fibres. In the case of very feeble sounds, the force of the sound-wave is only sufficient to produce a feeble perception of tone. The greater the excitation of the auditory fibres, the greater the perception of tone.

An individual note sounded within our hearing will excite in our ears only those Corti fibres which are completely, or nearly, in unison with that note; from which it follows that each single note of a certain pitch is perceived only by a particular nerve-fibre, and that different nerve-fibres are excited by notes of different pitch. If, then, a number of harmonious notes be struck as a chord on the piano, all those nerve-fibres will thereby be simultaneously excited to sensation which correspond to the several distinct notes contained in the chord. As, accordingly, the perception of notes of different pitch is a sensation associated with the stimulation of different nerve-fibres, so the perception of the different *timbres* must

result from the vibrations imparted, not only to those Corti arches which correspond with the tonic, but also to all those which correspond to all the harmonics of that tonic.

Owing to this wonderful construction of the cochlea, we are enabled not only to hear the most delicate shades of tones, but also to discover the individual notes of which a harmony consists.

Notes which are either too low or too high to correspond to the longest or the shortest of the Corti arches must therefore fail to produce any sensation of sound in our ear. In confirmation of the importance ascribed to the cochlea, Dr Hagen adduces the following: "There are persons who are not able to detect certain individual notes, or a certain succession of individual notes." He further says that he knew a composer who, by the shrill and vehement whistling of a locomotive-engine in his immediate vicinity, had been suddenly struck quite deaf to all notes above *e*, and after some time, also to the *d*, while he heard perfectly well all the notes lying below that *d*. This perfect loss of hearing as to a whole series of notes, caused by the whistling of a locomotive-engine, can be explained only by the assumption of a partial paralysis of the radial fibres of the basilar membrane and auditory cells, answering to the high notes here mentioned; and if one further considers that the whistling sound of a locomotive is not a simple note, but that it consists of a whole series of tones, it becomes evident why precisely the radial

fibres of the basilar membrane answering to the whole series of notes, and not those pitched for a single note, were paralysed.

Dr Hagen likewise records another case, in which a physician observed that, while suffering from an inflammation of one of his ears, he heard with the diseased ear all notes sharper by a semitone than he heard them with the healthy ear. It was only on the cessation of the inflammation that this phenomenon of double hearing ceased; and, says Dr Hagen, one can explain this peculiar phenomenon only by the fact, that the entire fundamental membrane, with all its radial fibres, in the diseased ear, had been put by pressure into a state of abnormal tension, and had thereby been, so to speak, put out of tune.

THEORY AND PRACTICE OF THE VOICE

THEORY AND PRACTICE OF THE VOICE.

HISTORICAL REMARKS.

THE human vocal apparatus is the most ancient musical instrument, for we have received it from Nature complete and perfect, and man used it, without any instruction, for the expression of his sentiments. Some naturalists believe that singing has been developed as a means of expression of the sentiment of love. We may also believe that the beauty of nature has stimulated the soul of man, and influenced his vocal chords to produce different tones. Most naturalists are of opinion that our earliest ancestors uttered musical sounds before they had acquired the power of articulate speech; and that in consequence of this, the voice, when used under the influence of any strong emotion, tends, according to the principle of association, to assume a musical character.

Surely the very first human couple did sing—perhaps, indeed, they did not always sing in tune; and I doubt if without culture and taste they could have sung a shake or a perfect *messa di voce*,—as, after all, the most essential conditions for the formation of noble vocalisation do not lie in the larynx, nor even in the cavity of the mouth, but still higher up—I mean, in the brain, in the intellect.

At a later period instruments have been manufactured by man. According to the Bible, Tubal-cain was the first instrument-maker.

The precise forms of the instruments used by the ancients are not quite known, but those first used were perhaps of wood, as the flute, &c.; then of metal, as cymbals, &c.; and later, when their intellect had been more developed, they used different string-instruments.

So far as our historical knowledge reaches, we find that music was everywhere connected with religion, so that we may say music and singing are as old as the desire of man to praise and magnify the Almighty.

Among the ancient Egyptians music and singing were much cultivated. In the reign of Sesostris, 1350 B.C., the priests had great singing-schools: at the head of each was a singer called "Ata," who had to conduct the sacred hymns and other temple music. The Hebrews and Greeks accepted their music, but they improved and ennobled it; and these two nations have been the source from which the music of the Christian Church originated. "Like two mighty streams, they

united together: from the Hebrews, Christian music derived its sacred character; from the Greeks, its form, its clearness, and its beauty."

The early fathers of the Church of Rome looked upon singing as the most powerful means to win the pagans to the true faith, and to keep together the persecuted Christians.

Clemens Romanus, who is held to have been a companion of St Paul, made it a rule that the psalmist or precentor was to intone the psalms, and that the presbyters of the Church were to be at the same time the directors of the choir. A favourite hymn was "Gloria in excelsis Deo," which Pope Telephorus (A.D. 127-139) first introduced into the Roman Church. Ignatius of Antioch (A.D. 116), Tertullian (A.D. 220), Origen (A.D. 254), and others, have all done much for church music.

Most of the old fathers have expressed their feeling and devotion in hymns, and so with Christianity there began to flow a rich spring of music. Ephräm alone, one of the fathers of the Syrian Church, who died A.D. 378, wrote about 12,000 hymns and antiphons, but the foundation of all this music was still the old psalm. Many hymns were simply translations or paraphrases of the Psalms of David.

Regular seminaries for singing existed in Rome at an early period. The first was founded by Pope Sylvester I. in the year 314. Another was founded by Pope Hilarius in the year 461. St Ambrosius, made Bishop of Milan in 374, wrote many beautiful

hymns. Some historians, however, doubt if the celebrated hymn, "Te Deum Laudamus," called "Hymnus Ambrosianus," is his work; others, again, seek to prove that he took it from the Greek Church, and only changed the words. In any case, he did much for church singing, and did as good service for the Western Church as St Basilius (A.D. 379) did for the Eastern.

The precise form of the Ambrosian melody is not known; nor do we know positively whether females, in the earliest time, took part in church singing, as it was only in A.D. 374 that the Synod of Antioch prohibited the singing of females in churches. The congregation did not long participate in the musical service, for at the end of the fourth century the Council of Laodicea ordered that only priests, or such as are instructed in singing, could take part in the choir. Pope Gregory the Great (A.D. 540-604) also would not allow the congregation to sing in church; only well-instructed cultivated singers were to sing sacred music. He founded in Rome a singing-school, and its influence was extraordinary, as the school was the foundation of the world-famed Sixtine Chapel, which for centuries preserved its reputation.

Gregory the Great made it an express law that no one, not an expert in singing, should be ordained priest. The Gregorian chant, in this way, took such a hold of France, Germany, England, and indeed all Christendom, that in divine service it was considered to be the sole musical expression of devotion. The

Emperor Charlemagne was also a great admirer of the Gregorian chant. The Synod of Aix-la-Chapelle, of the year 802, required of every priest that he should know how to sing according to the Roman rites. The later popes, too, devoted a remarkable degree of attention to the Gregorian school of singers in Rome.

The demands made upon these church singers increased with the growing efficiency of the Roman school.

A singer had to excel and shine not only by his voice, but also through his accomplishments, so that he might refresh the hearts of his hearers by the sweetness of his song. The following were the conditions for reception into the school. The singer's body must be strongly built and well-proportioned, the chest broad, the lungs sound and strong, the neck muscular, the palate well arched, the tongue well shaped, and the lips not too thick; the soft palate and the epiglottis were not to be long, and the teeth must be complete. The voice must be rich, powerful, of a metallic ring, agreeable in tone, uniform, and of large compass. Having fulfilled these conditions, the aspirant had to submit to from six to eight years of earnest studies.

We do not precisely know the form of the Gregorian chant, for the notation in which it is expressed appears to us perfectly hieroglyphic.

The imperfect notation was the reason that in every country the chants have been sung in a different way, after many modifications and different traditions. We

can now scarcely form an idea how these chants were originally taught by Gregory; but we may believe that they were of very simple structure, somewhat in the form of recitatives. Gregory's intention was that the congregation should direct attention to the words rather than to the music.

We must also mention Guido d'Arezzo in the eleventh century. He travelled from place to place, and gratuitously taught both poor and rich the art of singing. He bequeathed the so-called "solmisation" (ut, re, mi, fa, sol, la) to the world of song, throughout which, up to this very day, it is in use in solfeggio singing.

A truer and more elevated taste for vocal music was created in the sixteenth century by Palestrina, Nanini, and Anerio. What these were to the earlier Italian singing-school, Francesco Durante, Porpora, Pergolese, and Scarlatti have been to the modern.

We might say that down to the seventeenth century singing was only cultivated for the church, as almost every church was connected with a singing-school, but the teaching was one-sided.

More artistic singing began with the foundation of the opera under Peri, Caccini, and Monteverde. Caccini was a most accomplished singer. It is to him that we owe that graceful style of singing which in those days spread over all Italy, and which he imparted to innumerable pupils. In his work, 'Nuove Musiche' (1602), he gives excellent advice how to sing *gruppettis*, *giris*, and shakes. Luca Conforti (1591), one of the

Papal choir, first invented the method of giving forth a shake with sustained breath, and of applying it in music according to correct rules.

Real artistic singing was methodically and zealously promoted by the celebrated schools of Pistocchi, and later on, Bernacchi (1700-1740), in Bologna. We must also mention Porpora (1686-1711), to whom not only Farinelli, Caffarelli, and other vocalists, but our old Haydn, is indebted. Porpora taught at Venice, Vienna, London, and Naples. Leo and Feo had singing-schools in Naples, Peli in Milan, Tosi in London, who wrote the celebrated work on singing, 'Opinioni de cantori antichi e moderni' (1720); Mancini in Vienna, whose work, 'Riflessione pratiche sul canto figurato' (1774), should still be carefully studied by vocalists; G. Pacchierotti (1744-1821), a celebrated singer, who achieved great triumphs in London (1770-78); Gizzi Domenico (1684-1745) in Naples; his pupil, the celebrated soprano Conti, who adopted his name out of gratitude, and sang under the name of Giziello.

The celebrated singers of the eighteenth century were mostly eunuchs—Ferri, Senesino, Nicolini, Berselli, Orsini, Farinelli, Caffarelli, Carissini, soprano of the Bernacchi school. The celebrated prima donnas were Tesi, contralto, who with great success sang in 1719, at Dresden, airs originally written for a bass voice; Faustina Hasse, soprano, Cuzzoni, Agujari, Mara, Todi, &c.

Most historians praise the period before Gluck as the golden era of vocal art. So far as the technical part of

singing is concerned, it is true. The masters of that period were mostly great singers. Their method, which will be the standard for all time, consisted mainly in the cultivation of the *portamento*, and the development of the voice, with noble formation of tone. The vocalists of that period excelled mostly in singing long phrases with one breath; some of them were real breathing-machines. I only remind you of Farinelli, one of Porpora's pupils, who made in a theatre at Rome a match with a trumpet-player (see 'Musical Education and Vocal Culture,' p. 39). They cultivated for years especially *messa di voce*. No doubt it is of the greatest importance and value that a vocalist should be able to sing a perfect *messa di voce;* but to use it in every note, to introduce it in every composition, as the old masters sometimes did, was inartistic. Mancini, in his work, 'Reflessione pratiche,' for example, says: "Un vero ed ottima artista se ne serve in qualunque nota di valore la messa di voce"—"A true artist avails himself of the *messa di voce* in every note." The greatest artists of that period often forgot to keep the right time, when they had to sing a *messa di voce* which was suitable for their voice. From that period we probably derive the term *tempo rubato*. They gave to one note what they stole from another.

They only sang pieces to demonstrate their *technique* and their breathing faculties; and the compositions themselves were not of such great value, variety, and character as those heard in our day. The most difficult

part of singing—I mean, the interpretation of real dramatic music—was very little known at that time, and therefore, with all their excellent method, their singing was not very intellectual. With the old Italian vocalists singing was more sensuous. In our day we preserve more intellectual beauty in the tone of the voice. Happy those who can combine both!

The traditions of the old Italian schools have been bequeathed to Caselli, Aprili, Bordogni, Ronconi, Concone, Marchesi, Garcia, Lamperti, Varesi, G. Engel, Sieber, Stockhausen, &c. All these masters taught, and some still teach, the old Italian method; but it is no longer Italy alone that teaches good singing. Every country has some intelligent teachers who are singers, and who have accepted and studied the old Italian method; and every town should have such masters, as these only can foster and further true vocal art.

ON CHILDREN'S VOICES.

No doubt we have in our days made great progress in the science of teaching; still I would call the modern education one-sided, as we do too much for the development of the intellect, and too little for that of the heart and soul.

We should rather aspire to bring about a harmonious development of intellect, heart, and soul; in other words, harmony of all the mental and emotional faculties.

Instruction has not only for its object to supply the scholar with useful knowledge, to sharpen his intellect, to develop his brain; it should also serve to ennoble mankind and to adorn human life.

We must enliven the prosaic aspect of our existence by music, song, and poetry, and singing in particular should be considered as a primary means of education; it should be cultivated as a physical means of strengthening the lungs and the pulmonary organs.

In the middle ages singing very seldom was wanting as a part of instruction. In many monasteries it was cultivated with much care and expenditure of time; and certainly it now deserves more attention than it receives, for we possess no better means for education and culture than beautiful song.

Sound is accessible to every one who hears; the language of musical tone is comprehensible to all men. The innocent child in the cradle listens with pleasure to a song; his mother breathes her love to him by it, and what words cannot yet tell him, the tone of her voice expresses, distinct and clear. It is the same with grown-up men. Egotism disturbs unity; music unites the whole world.

Where mere language fails, music may have powerful effect; it unites men, and makes them brothers. Thousands of people who meet at the Rheinish and Händel festivals, coming from all parts of the world, become one heart and one soul amid the stream of song.

A noble tone stirs the depths of feeling; passing by

the exterior world, it reaches, through the ear, the heart of the listener, and touches the various chords of his feeling. As the character of the tone, so is the effect produced; the nobler the tone, the more is the heart, the feeling, of the listener elevated. A merry song makes us happy, a plaintive song renders us sad, a solemn song lifts our soul heavenwards, a spirited festival song inspires us, a pithy song of freedom steels our nerves for noble deeds. Song is not only the servant of beauty, but it leads through the beautiful to the good.

In the middle ages we had no Händel, Haydn, Mozart, Schubert, Franz; no words by Goethe, Rückert, Milton, Tennyson. The compositions of our classics have a great influence on civilisation; they enlighten the intellect, they warm the heart, they give nourishment to the mind and soul, and therefore play a great part in the education of the race.

The educational authorities of our time seem not sufficiently to recognise this. In every country there is more or less bad singing in the elementary and public schools, and the particular reason of this is the neglectful way of treating the children's voices.

Writing, reading, drawing, mathematics, geography, history, physics, and all practical subjects are practically taught, but singing is only treated incidentally; and if any one complains of the bad singing in schools, and asks the teacher to account for it, he answers, "We have not sufficient time to cultivate it." Therefore the

teachers now and then sing or play different songs before the children, and, so to speak, blow the tunes into their heads: the classification of voices is little or not at all considered, and all sing in unison.

Children have a great desire to demonstrate their voices in choir-singing; one out-cries the other, and when they come to the high notes they press, scream, and shout with great waste of breath, and this is what in modern times is called "vocal culture in public schools." Teaching of singing in public schools should be roused to a pitch of greater efficiency, and that by some radical alteration in the present method.

First of all, it must be treated with more care: more time must be dedicated to singing; teachers should give individual instruction, and proceed rationally, not in a one-sided way. They should begin with breathing exercises, position of the mouth, correct pronunciation and articulation, reading of music, cultivation of tone, and only after this should they begin with songs.

Is it not better, instead of imperfectly learning fifteen songs in a year, to learn only two, and to sing those two songs pleasantly, than to sacrifice the whole voice for the sake of gaining a large repertorium of songs which, after all, one cannot sing? Songs must be preceded by vocal exercises. If this is neglected, and the voice not equalised, and the pupil only taught to read music, he has perhaps learned to read well after a year, but has no longer any voice wherewith to sing the sim-

plest song pleasantly; he will, at most, only be more musical, but not be improved as a singer.

Irrational, heedless training of children's voices injures them permanently. If the vocal chords have lost their elasticity, nothing to be acquired either from the higher schools or from the best private instruction will supply the loss.

No master will cease with the alphabet when teaching a child to read; we begin with the alphabet, learn afterwards to spell, and then to read.

All success, all progress, in art, depends on making a good beginning. It does not take more trouble to teach or learn a subject well, than to do it ill; but if the beginning is bad, and based on false principles, the pupil may take ever so much trouble with or without a master, but he will not make any satisfactory progress, —the results will ever remain defective, and will never lead to the perfection which might otherwise have been attained.

A methodical foundation is indispensable in all studies, and specially so in vocal instruction. It is almost a crime to ruin so precious a gift of nature, the most valuable possession of man—I mean the voice—by a thoughtless way of teaching. Class-singing is particularly to be condemned. The teacher must therefore individualise; for it often occurs that a child of nine years is superior to a child of ten as to its musical faculties; a boy of twelve years may be more endowed with vocal talent than a youth of seventeen.

The great number of pupils surrendered to the singing-master in public schools can only derive advantage if individual instruction is introduced, and if each pupil knows the foundation of vocal culture. There is no other method from which sure progress may be expected.

The first studies, the first steps, decide and make the future singer; but if the child's voice has lost its softness and beauty through shouting and overstraining, the best master will never be able to restore them.

In the proper use of the vocal organs lies a guarantee for their endurance, as it is the principle of every good method to demand the least possible effort of muscles for the greatest possible effect.

It is a fact that uncultivated voices, with great waste of muscular strength, fail to produce an effect for which a slight effort would have sufficed. Children's minds, like their voices, are soft and susceptible; the children of the present form the men of the future.

The ear can be cultivated from the first year. Professor Preyers tells us in his work, 'The Soul of the Child,' that "when singing before a baby fifty-one weeks old, it stared at his mouth for a minute, with motionless features and eyelids, finally moving its own tongue. The faculty of perception for words wakens; the child turns round when it hears its own name; of course it does so also at the sound of other noises, but then with different expression."

To speak well, we learn by the ear without knowing

it; by the same ear we learn to appreciate good singing; and each mother should consider singing as a part of the child's education which falls to her.

From the first days of our existence the ear becomes accustomed to good or bad sounds. The more it hears of the better ones, the more susceptible does the child's ear become to them.

Gounod, the composer of "Faust," says: "My mother had made me her pupil as well as her nursling. Hence my perception of airs, and of the intervals composing them, was quite as rapid as my perception of words, if not more so. Before I could speak, I distinguished and recognised perfectly the different airs with which my ears were lulled." It must not be concluded that a precocious culture of the ear is sufficient to make a musician capable of composing; but it is certain that one can initiate the ear to musical language exactly as to spoken language, and can develop the musical sense in a much larger number of children than is commonly supposed. I have known children sing false because their mothers and nurses sang false, and spoiled their ear. It is not the voice which is false; it is the perception of the intervals which has been falsified by vicious culture.

Children should never hear impure tones at home, nor play with toy instruments which are out of tune; in short, they should have no opportunity of hearing bad music.

None of the arts speaks so mightily as music to the

soul; no muse takes such a hold on our emotions as that of music; and therefore children should only hear sounds which are good and pure. These first impressions, and the love of pure tones induced by them, must have a decided influence on the whole being. Children must be accustomed to harmony in order to radiate harmony around them. We must bring harmony practically into life. The three-cord thread is—humanity, kindness, love; and these all prevail in music.

Children should enjoy only good instruction. By offering the early opportunity of singing properly, we strengthen lungs and chest, and through these the whole physical constitution of the child. In a healthy body we always find a fresh mind and a peaceful heart.

We know by clinical experience that the thorax is less elastic in maturer years. Dr Kotelmann ('Die Körper-verhältnisse der Gelehrtenschüler des Johanneums in Hamburg—Berlin, 1879) compared the volume of the chest in greatest expiration and deepest inspiration with the following results:—

Age.	Volume of the Thorax.		Annual Increase of Volume.	
	Greatest Expiration.	Deepest Inspiration.	Greatest Expiration.	Deepest Inspiration.
9	58.71	65.83	...	...
10	60.35	67.51	1.64	1.68
11	61.95	69.48	1.60	1.97
12	63.48	71.30	1.53	1.82
13	64.83	72.29	1.35	0.99
14	68.23	76.07	3.40	3.78
20	82.40	91,65	1.00	1.09

Hence the chest is more expansible in a boy than it is in a grown-up man. At the time when the voice is breaking, towards the fifteenth year, we observe the greatest increase in the volume of the chest. It is therefore of great importance for the health to have in early years a sound foundation and thorough instruction in singing, for nothing widens the chest more than artistic singing.

A relatively small thorax is not only the cause of many a bodily illness, but it has also a decided influence upon our thoughts, our feelings, and our actions. The proportions of the mental activity are different if the capacity of the thorax is smaller or greater, and the heart beats within a narrower or a more spacious abode.

Immanuel Kant says of himself that, on account of his flat chest, he had a natural disposition to hypochondria, which almost reached to weariness of life. Kant felt his chest uneasy, but his head was calm and clear. As the world, however, does not consist of philosophers only, it is advisable to do betimes all that tends to the expansion of the thorax; because a narrow chest does not allow sufficient space to the movements of lungs and heart, and is likely to produce hypochondria in men with ordinary heads.

Through gymnastic exercises, and also through correct singing, we should endeavour to develop our thorax; then our heart will beat with ample freedom, and hypochondria, with all its attendant evils, cannot have any scope.

Correct singing is more to be recommended than gymnastics, because it is an exercise more stimulating than fatiguing. It is stated by physiologists that by the latter the supply of blood to active muscles is considerably increased, the oxidation of tissues rendered more active, and the nourishment of the muscles improved, provided that by the digestive organs there is assimilated a corresponding quantity of materials containing albumen, failing which the gymnastic exercises will have a more fatiguing effect. Hence the gymnastics in elementary schools, particularly in poorer districts, should be carefully practised. It is very important that the quality of food should be in due relation to the change of substance occasioned by the activity of the muscles. Wherever there is lack of sufficient appropriate food, the organism consumes its own store of fuel, the fat of the body is used up, and the body becomes thin and tired. Artistic singing strengthens the body without fatiguing it; and it will, especially with poorer children, repay the trouble by a better bodily proportion. We do not mean by this to say that we could strengthen ourselves by artistic singing without food.

Children's voices must be very carefully treated; and the teacher must follow with great attention the gradual lowering of the voice. A child should only be allowed to sing notes which are attacked with ease and sound pleasantly, and should never proceed to the more difficult problems of music until its elements have been thoroughly conquered.

THE MUTATION OR BREAKING OF THE VOICE.

This is in close connection with the whole development of the body. The climate, too, has a great influence upon the breaking of the voice. The more intense the light, the sooner does every living organism come to the height of its development. Hence, on approaching the equator from the poles, one finds the maturity of man at an ever earlier stage of life, his cast of features more and more decided, his temperament more distinctly marked, the action of his nerves more intense.

It strikes every observer that the breaking of the voice occurs in southern countries four or five years earlier than in colder regions. In our country the mutation of the voice occurs in boys between 14-18, in girls between 14-16. The breaking of the voice occurs later if the intellect is overstrained or the body insufficiently cultivated and fed; but even in colder climates, though there be ample nourishment, if this is accompanied by undue excitement of the senses, the breaking of the voice occurs earlier.

This great change is shown by the roughness and hardness of the voice, by uncertainty of attack, and by cracking of the voice, not only in singing, but also in speaking. Dr Liscovius says: "One fails to give the tone one wishes; one miscalculates the higher notes. It is sometimes like a man who, having lived for many

years in a house, and then removed into another, sometimes wanders into the old house, until he is as accustomed to the new one as he was to the old."

In this way low tones and higher ones often get mixed, and then we say the voice is cracked.

At the period of mutation the voice must be very carefully managed; to economise is then the first condition of its preservation. The individual must during this period speak in moderated tones, and strictly avoid straining his voice even in speaking. Schoolboys should especially avoid shouting in the open air during their games, as, through straining the voice at this period, they lose for ever all softness, roundness, and beauty of tone.

During mutation, all the organs of the larynx are reddened, the vocal chords become thicker and longer; while at complete maturity all the breathing passages have acquired their individual forms and proportions, and retain these during the rest of life. "No amount of singing lessons," says Professor Merkel, "and no kind of exercises for the larynx, can add a single millimetre to the length of the glottis, or to the cartilages connected with it, although such vocal gymnastics may very considerably influence the nutrition and the skill of those organs."

Between the sixth and the eleventh year of life the larynx seems to undergo but little change in its general structure, which then is pretty much the same in boys and girls, although, even before attaining maturity,

the larynx of boys presents somewhat longer and firmer vocal chords than that of girls.

During the breaking of the voice, the female larynx grows more in an upward direction than it does in length and depth; all its parts remain more delicate, flexible, and slender than in the male, and the cartilages become proportionately harder, stouter, and more angular. The female vocal chords are shorter, thinner, and narrower, and show more tension than in men.

According to Professors Luschsca and Merkel, the male larynx is by one-third larger in volume than the female one, and has six times the size of that of an infant. According to Richeraud ('Recherches sur la grandeur de la glotte') the difference in the size of the larynx is not very appreciable during the age from 3 to 12; and the diameter of the glottis in particular remains pretty constant, at a length of about five-twelfths of an inch. About the time of maturity the growth of the larynx progresses very rapidly, until it reaches its full size; the glottis takes less than a year to increase in the proportion of 5 to 10 in the male, and of 5 to 7 in the female larnyx. Previous to this period, sex seems to be immaterial, both as to the size of the larynx and of the glottis, in individuals of equal age, so that the difference between the male and the female larynx becomes decided for the first time when the voice has settled. Then the length of the glottis is, according to Wh. Müller, 18.5 millimetres in men, and

12.6 in women; according to Harless, it is respectively 17.5 and 13.45 millimetres.

The latter physiologist gives the length of the glottis in a girl of nine as 9.5, in a boy of fourteen as 10.25 millimetres. There, too, we find a confirmation of the fact that during the breaking of the voice the female larynx changes less than the male one. (See also lecture, "The Influence of Climate, &c.," in my work on 'Musical Education and Vocal Culture.')

During mutation the voice is more irritable, and more sensitive to overwork. The best sign that the period of mutation is over, is if the young singer attacks the middle notes of his voice with certainty and purity, and if he can start the high notes with ease. Just after the mutation is complete, the voice sounds weak and has no brilliancy; but after careful practice it recovers freshness and fulness.

There are some who think that the hoarseness of the voice in the period of mutation is caused by a cold, and they irritate their organism through repeated hawking, or slight coughs, which do great harm to the voice, and render it weak and disagreeable.

If a sonorous voice of a child becomes weak, and has no *timbre* after the mutation, we may take it for granted that during the period of mutation the voice has been badly treated, or that, before the voice has completely settled, it has been injured.

Singing *messa di voce* on high notes, especially for a long time, also ruins young voices; and choirmasters

and organists should therefore not allow the practice of *messa di voce* on high notes; and only for a few minutes daily should *messa di voce* be practised on the middle notes, or on such high notes as children can produce with ease and beauty.

It is wrong to suppose that every soprano must turn a tenor, and every alto a basso, after the breaking of the voice. With a voice on its way to become a basso, the period of breaking generally passes more rapidly than with a voice turning tenor. It is also not always the case that deep voices possess stronger, thicker, vocal chords than high ones. The celebrated tenor Sontheim had, according to Dr Fieber, vocal chords such as we only find in bass and baritone voices.

It occurs sometimes that the voice of a young man in his riper years breaks a second time, and a tenor voice changes into a baritone, or a baritone into a basso. We are told by H. Mendel that Theodor Formes, a celebrated German tenor (born 1826), brother of the well-known basso Carl Formes, had, as a child, a fine soprano voice, and was very musical. After mutation his voice became a beautiful bass. In 1843 he was studying at Vienna under Hiffel, and after three months of practice his voice broke again and became a sonorous and beautiful tenor. Carissini, soprano of the Bernacchi school, whom we have mentioned on p. 15, was another instance of this singular second change; for his voice changed from soprano to a most beautiful contralto.

Before the child's voice breaks, we observe a gradual

lowering of the voice, and as soon as we observe this, the soprano must be ranged with the lower voices, the altos. When the *real breaking* of the *voice* begins, *singing* must be *entirely given up.* If the soprano singer is then forced to sing the high notes, the voice will lose all its beauty, and the unfortunate pupil will, in spite of his musical knowledge and good reading, lose all beauty of tone.

With alto voices the same thing occurs as with sopranos—they sink gradually from the alto to the contralto. Before the change, the voice becomes almost of the tenor compass, and it is necessary to join it there when it is used in choir-singing; though the *timbre* of these voices is different, they sound very well in the choir.

Children's voices undergo three changes during the breaking of the voice. They change from soprano to mezzo-soprano, then into alto, and lastly to contralto.

If a child's voice sounds sharp and unpleasant, we may be sure that it is overstrained, and we must immediately transfer it into a lower and more comfortable range of duty.

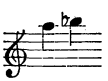
Even after the breaking of the voice is all over, we are not allowed to fatigue it with *messa di voce;* but must gradually proceed from the easier exercises to the more difficult, and so strengthen the voice.

THE COMPASS OF CHILDREN'S VOICES.

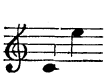
The whole compass of children's voices is—

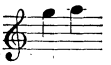
In the 5th year of age,	. . .	5-6 tones.
„ 6th „	. . .	6-7 „
„ 8th-9th „	. . .	7-9 „
„ 9th-12th „	. . .	9-11 „
„ 12th-14th „	. . .	11-14 „

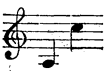
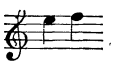
Girls voices gain gradually in their compass between the sixth and thirteenth year. The lower limit of the voice sinks more and more with the growing age, whilst the upper one only rises till the eleventh or twelfth year of age, and remains unchanged thenceforth.

On an average, girls' voices gain four lower and from two to three upper notes. The of the grown-up soprano I have never heard from girls in this country: their highest notes were 

The soprano of boys generally is one or two half-tones less in compass than that of girls. If, therefore, boys and girls with soprano voices sing in a choir, only the girls should be allowed to sing the higher notes. When the falsetto is cultivated, and the boys are able to sing with ease the highest notes, they can join then in singing them.

The soprano of boys takes easy the compass of 

With artistically cultivated falsetto he reaches  like the feminine soprano. Of course they differ considerably from each other in their *timbre.*

The alto sings with ease from  and with cultivated falsetto up to  like the feminine alto voice.

Children's voices are commonly sharper than the softer sounds of the woman's voice, the latter being less connected with well-marked partial tones.

THE READING OF MUSIC.

To assure a speedy acquaintance with the notes and intervals, I should recommend the following, in place of the usual uninteresting and tiresome exercises, for the singing of intervals: Let the master ask the pupil for the songs he is already familiar with, and select from these such as begin with different intervals. Let him then explain to the pupil the first interval with which each song begins. It is a well-known fact that most children sing the intervals perfectly in tune before they are able to read music. Intervals and melodious combinations lie, as it were, slumbering in hazy outlines in the musical imagination of the child, and require only

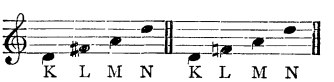
to be awakened and made to live. While the pupil is singing the first interval, let the master write it with chalk in large and legible notes on a black-board. By this means the eye will be made to support the memory for tones, and after some repetition of the experiment the pupil will have acquired in an interesting manner familiarity with the intervals and notes throughout his own songs. I hope this suggestion may meet with the approval of teachers and choirmasters. I give a list of well-known songs beginning with different intervals (see p. 152). It will be understood from what has been said above, that the teacher has to select songs which the pupils are in the habit of singing, or which they have frequently heard.

While writing the notes on the board, and having them sung by one of the pupils, the others should be encouraged to imitate the intervals mentally; and in order to test the attention of the pupils individually, the teacher may reverse the board and call on one or other of the pupils to repeat the intervals noted down and explained, and to write them for himself with chalk on the board. Calling on the pupils—not in the order of their places, but simply at choice—will be the means of enforcing the attention of the whole class.

It is presumed that the pupil has a good musical ear, and these exercises will be found a means of exciting and developing it. Although readiness in intoning a

pure interval certainly presupposes a good musical ear, still it is by practising on intervals that the ear is finally brought to the greatest accuracy.

I recommend as a good exercise for correct intonation the singing of chords in four-part harmony as on p. 147. This and similar chords are also to be practised on the minor scale. The notes of the chord should not be sung simultaneously, but first individually, one after the other. Let us name the pupils K, L, M, N, and make them sing the chord of *D* major, and afterwards the chord of *D* minor, for example—



Afterwards they must change, and sing L, K, N, M; L, M, K, N, and so on. Only after having sung these and similar chords repeatedly and with the changes indicated above, the pupils may be made to sound the chord together on a signal being given by the teacher. Of equal practical value I consider the reading without singing of music new to the pupil, which may be combined with the marking of the intervals with pencil. The reading of music new to the pupil is a great means for exciting his attention, which is in itself a gain. After having been examined by the teacher, the pencil-markings may be erased, in order to make the piece serve for use again. Very young children must not sing from music, but by the ear. Their instruction should awaken their love for song, but it would rather

be a weariness if it were to be thorough, and they might lose all pleasure in singing. Thorough or technical instruction should begin only with the ninth year. The fact is, that the impulse towards musical culture must be given long before theoretical teaching is commenced, and the training of the ear is the first step towards that end. Nutriment for the child's musical life consists in what the mother sings and plays to him, but the mother must know how to descend to the child's capacity. Thus she should for the most part sing songs that cheer the young heart, and stimulate the nervous life. Nor is it sufficient that mothers should sing their songs for the children pure and true in tone, they should also endeavour always to speak to them with a pure and beautiful modulation of the voice. It is farther of great consequence that only persons with a true and pleasing voice and a pure pronunciation should be selected as nurses. Harsh and low voices frighten the child, and inevitably impair its musical capacity.

EXERCISES FOR TWO-PART HARMONY.

In singing-studies for two voices in a class, the sopranos and the altos may interchange their parts. It will be found that in the earlier practising, the alto voices are apt to go wrong, because they have a natural inclination to sing the melody of the sopranos. This tendency is best checked by at first calling upon the

whole number of the altos to sing, while only a few sopranos represent the melody, until in due course the whole class may join. The lower voices should not sing stronger than *mezzo-forte*, seeing that alto is properly only an accompanying voice.

ON RHYTHM.

Every activity of the human soul implies the idea of motion, and the fairest of all human arts—music—is essentially founded on motion.

Sulzer, in his 'Theorie der schönen Künste,' says: "Rhythm is a periodical intersection of a series of things of a uniform nature (as, for instance, sounds, beats), whereby the monotony in these things is coupled with variety, so that the feeling excited by prolonged attention to such a series, which would otherwise be that of a wearying monotony, obtains change and variety, through rhythmical division." Rhythm is innate in man. It exists, indeed, in the very beat of his heart and pulse. Children have been observed even at the age of nine months to accompany music they hear with rhythmical movements. In the step of men, more especially in the marching of soldiers, we observe rhythmical proportions: nay, Quintilian draws inferences as to the character of a man from his step. A spondaic step, for instance, indicates in his view a sedate and sensible character; a trochaic or pæonic

step bespeaks an active and high-spirited mind; a pyrrhic step in walking is ignoble and mean. A step sharing all the qualities mentioned would, according to Quintilian, indicate a wild and extravagant person; an irregular motion would point to wantonness and disorder.

The feeling for time may be called out in children by making them march to the beat of a drum, or to the sound of any other instrument. Marx observes that the feeling for rhythm is inborn in every being endowed with reason; and he thinks that, if we notice how bodies of raw recruits keep step, or how threshers naturally fall into a methodical stroke either in common or triple time, it will not be disputed that this feeling for measure is common to all men, and that it is only through neglect of the natural capacity that it is lost. As a matter of course there are different degrees in this as in every other natural capacity. For the development of the feeling for time, it is important that the pupil should first practise under the superintendence of the master. The playing as duets of good music, in an easy arrangement of simple melodious marches, and the like, would make a good beginning, and afterwards more complicated rhythms may be taken up.[1]

We have different degrees of motion in musical pieces, and the motion in which a piece of music is to be performed is called the *tempo* (time).

[1] I would recommend Schubert's songs for four hands (Peter's edition).

We have slow, moderately slow, moderately quick, quick, and very quick measure,—*largo, larghetto, allegretto, moderato, allegro, presto,* and so on.

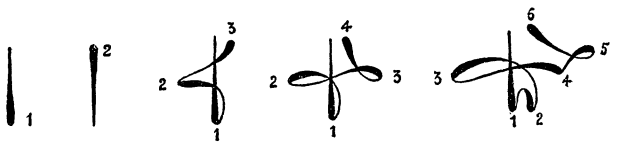
There must be a methodical arrangement in all musical movement. In the same manner as it makes a disagreeable and confusing impression on the eye to see in any object parts of the same nature introduced without order and proportion, it will make disagreeable and bewildering impressions upon our feelings when the parts of a melody do not stand in a true and symmetrical proportion to each other, and when melodic phrases of two or more bars are thrown in confusedly, without choice or regard for fine rhythm. Again, in the same way as our eye soon feels tired when there is no animating variety even in methodically arranged parts of a whole, so also our ear and our artistic feeling are soon wearied when melodies are composed of nothing but phrases of two, or three, or four bars, without any variety in them.

To accustom the pupil to keep proper time, it does not suffice to let him see how the teacher beats time, but he himself must learn to beat time with his right hand. These movements must be executed with great precision. The more energetically they are performed, the more favourably will they influence his feeling for time. After careful practice, his feeling for time and rhythm will become a second nature.

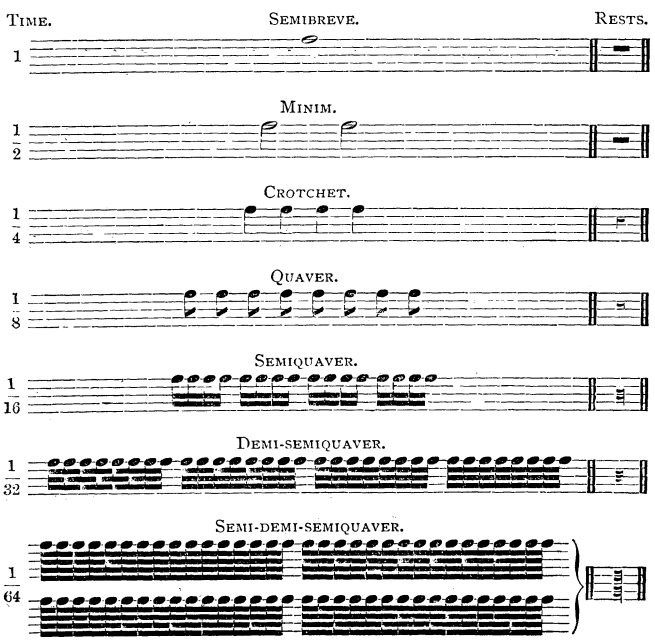
I should not, however, like to see all pupils acquire a confirmed habit of keeping time with the hand. It

is only those in whom the feeling for time is not sufficiently developed who ought to do so.

The following are the diagrams for the motions to be executed with the hand. On the part of the line emphasised in these figures the beat must be full:—



TIME, NOTES, AND RESTS IN MUSIC.



What children are to sing in time, they must first be able to speak in time. Each exercise, therefore, is first to be read in proper time by the individual pupils, and after this by the entire class, and this in such a way that the name of the note is distinctly repeated at each recurrence of it, and sustained each time according to its proper value. Where a rest occurs, its value must be counted aloud.

BREATHING.

Life depends on breathing; singing on artistic breathing. The first breath is the beginning, the last the end, of our life. The breath is like the oil in a lamp: just as the lamp ceases to give light when the oil is consumed, so in the same way the sound ceases whenever the breath is exhausted. In ordinary life we breathe involuntarily, for we breathe while we sleep; but for artistic singing we must study the art of breathing, so that we may become able to sing a great deal with a small volume of breath; and the old Italian masters justly said, "The virtuoso in breathing is nearest to the virtuoso in singing." The student should, above all, first distinguish between superficial and deep breathing, and avoid the former. We may occasionally use the natural light breath, if the nature of the composition allow it. This light

breath the Italians call *mezzo respiro*, but this method of breathing requires no special study for its acquisition.

Superficial or light breathing consists in the elevation of the upper ribs and the breast-bone and collar-bone, and is therefore sometimes called collar-bone breathing. In this way but a small portion of air is taken in, and it goes, of course, no great distance beyond the windpipe. The breath remains constantly close to the larynx, and makes the singing strained and breathless, with an ungainly heaving of the chest; and breathing in this way makes one tired after a very short time.

Instead of this injurious mode of breathing, deep breathing is to be persistently cultivated. To this end the lungs should be allowed to expand most freely in the lower part of the chest, the diaphragm being energetically contracted. In this way a far greater amount of air rushes down into the lower lobes of the lungs, which then rest flat on the diaphragm, than by the gasping for air with the mouth which accompanies superficial breathing.

Let the student diligently practise the art of firmly retaining, by the deeply depressed diaphragm, the breath thus obtained, and allowing as little as possible to escape upward. This healthy way of breathing, which strengthens not only the lungs but also the organs of digestion, should be practised daily in pure

and fresh air, particularly in the morning, even when one is not singing.

It is a matter of course that calm deep breathing conveys more air into the air-channels than the ordinary way of superficial breathing. Accordingly, by the first method a larger quantity of oxygen is introduced into the organism, we widen our chest, we strengthen our lungs, and we improve our digestion. The inspiration must be an imbibing, and the expiration a gradual flowing out rather than a rushing in and puffing out of the air.

The best and simplest way to accustom one's self to deep breathing is to stand upright, and, folding one's hands on the top of the head, to draw in the air as gently and as deeply as possible, retaining it well down by the diaphragm for from ten to twenty seconds. I may also recommend the following as being to the purpose: Pass a stick across the back through the bend of both the elbows, taking the arms well forward, and in this position breathe gently and deeply. By this procedure diaphragmatic breathing is induced to a remarkable degree, whilst it is also conducive to a good carriage.

The following two exercises are also advisable: Join the hands behind the back, carefully maintaining an erect posture, so that the shoulders are drawn well down, and breathe deeply. The second is, breathe deeply and slowly through the nostrils, 20 to 40 times, during inspiration bring the arms up to the level of

the shoulders, and during expiration let them fall slowly down.

The student should, as often as possible, breathe quietly through the nose, and retain the air in the lungs by contracting the diaphragm. The shoulders must never be drawn up, only the chest is to expand and to arch out forward, and then the air should be allowed steadily to stream forth for the formation of the tone. The expiratory muscles must never force the air against the vocal chords, but should allow it to flow out gradually, otherwise the voice will tremble. If we force the air against the vocal chords they are disturbed, and their regular wave-like vibrations are interrupted: by this a shaking and trembling is produced, resembling that in an organ when the influx of the wind into the mouthpieces of the pipes is too sudden and vehement. We often hear amateurs who sing *forte* without producing a full or pleasant tone, while with an artist, even when singing *piano*, his tone is full and round. The secret is, that the latter allows no waste air to escape through the vocal chords without producing sound. The amateur loses a great deal of breath without bringing the air into sounding vibration. One part of the air thus needlessly escapes, and the tone is consequently weak. If the singer, therefore, in producing a tone, uses too much air, his tone will lose in fulness and body, just as an oil-picture loses in beauty and clearness if the artist uses too much oil.

The middle notes of our voice require the least air; the lowest and the highest notes require more. The ability to produce a beautiful rich tone with the most moderate expenditure of breath betokens the artist, and every singer must aspire to this accomplishment. We repeat that deep breathing is, besides, conducive to health, and experience shows that most of the best vocalists are possessed of a far greater breathing capacity, and therefore enjoy much better health, than persons who do not sing, and who lead a sedentary life. Methodical singing, since it effects an increase of the respiratory capacity, is the best muscular exercise, and, in a relatively short time, does more for the invigoration of the lungs and for the increase of their volume than any form of athletic exercises.

The singer's first care must be for a constant and liberal supply of fresh air in the rooms he occupies; and still more attention ought to be paid by teachers in large schools to constant ventilation, and to the liberal supply of pure and oxygenated air.

I think we should devote as much attention to the supply of good fresh air as to that of good pure food. We continually use the air in breathing, while we eat and drink only from time to time. In the olfactory organs nature has given us something with which we may perceive noxious elements in the air, and we should therefore cultivate our sense of smell—cultivate it as much as our palate, for what the palate is for food the nose is for the air.

It has been proved that, in the case of singers, by the energetic and more complete ventilation of the lungs, not only is an increased oxygenation but also an increased decarbonisation of the blood effected. A larger percentage of carbonic acid has been discovered in a volume of air in which respiration by deep breathing had been kept up, than was found in an equal volume of air affected by respiration in shorter inhalations.

Portamento, legato, and the *messa di voce* (*crescendo* and *decrescendo*), require particularly quiet and deep breathing. These styles of singing, accordingly, increase both the oxygenation and the decarbonisation of the blood.

The regular daily practice of singing strengthens not only the lungs and the voice, but the whole constitution. The deaf and dumb have therefore a defective development of the thorax and the voice, and are disposed to consumption, and the greater part of them depart from this life in their youthful days, after the breaking of the voice. Dr Meissner gives a list of fifty-one pupils who died at the Leipzig Deaf and Dumb Institution: in forty-nine the cause of death is given, and in not less than thirty-two of these the cause was disease of the lungs.

Not only for technical but also for sanitary reasons should children from their seventh year sing daily vocal exercises within the compass of a sixth or an octave. The earlier in life a child begins to sing, the more easily and the sooner does he widen his thorax,

the parts of which are in childhood cartilaginous, and therefore specially capable of expansion. The organs of the voice have also at the early age the greatest flexibility and pliancy: through deep inspirations and full expirations they strengthen the inner parts, and the development of the inner organs is as important for the health as that of the external ones. Physicians have therefore recommended singing at an early age as a remedy against consumption.

Breathing-exercises should be engaged in also by persons troubled with phlegm, and a tendency to congestion of the lungs. These breathing-exercises do not only effect a thorough ventilation of the lungs and a clearing of the bronchial tubes from phlegm, but they also facilitate expectoration, and give the sufferer a peculiar feeling of relief and comfort in the cavity of the chest.

The following results were obtained by Professor Monassain from an examination at the St Petersburg hospital of 222 vocalists. The relative as well as the absolute circumference of the chest in singers is larger than in those who do not sing, and it increases with the age and with the time devoted to singing. The expansion of the chest and the vital capacity of the lungs are greater in singers than in other persons, and they likewise increase with age and practice. While catarrhal affections of the larynx are of frequent occurrence among vocalists, they are seldom attacked by bronchitis. Very few vocalists die of consumption.

Singing being, as it were, a gymnastic exercise of the lungs, is thus an excellent prophylactic for those who have a tendency to pulmonary diseases.

THE POSITION OF THE MOUTH.

A correct position of the mouth is one of the first conditions of the production of tone in singing. If the position is faulty the *timbre* is muffled and obscured, the development of a refined tone is rendered impossible, and the voice is made unfit for artistic purposes. The cavity of the mouth might appropriately be called the "vowel-cavity," for we know from Helmholtz that the vowels are constituted by the harmonics peculiar to the cavity of the mouth, according to its different shapes, and that these harmonics are produced by the current of breath from the windpipe, and pitched at different heights by the different degree of tension of the vocal chords situated in the larynx. Accordingly, what we call vowels is the *timbre* of the voice as resulting from the shape of the sounding vibrations in the cavity of the mouth in that peculiar form which it assumes for each vowel. It is impossible to fix upon a definite measure for the height of the aperture of the mouth, for this differs according as the mouth is small or large. The height of the cavity depends partly on the structure of the mouth and partly on the different vowels we sing. Under no circumstances, however,

should the mouth be opened either too much or too little; and if we consult the laws of beauty respecting the appearance of the mouth, we should have an elliptical opening ⌓. This position is best achieved if the lips are distended towards each side as if for a smile, and this condition can be most completely realised in singing the vowel *a* (ah).

The upper teeth should become visible to about half their size, while the lower teeth should be almost completely covered. The upper lip should accordingly be somewhat raised. We should guard against allowing the lips to cover and rest on the teeth, because they would then absorb the tone like sponges, and make it sound dull. It is through the medium of the teeth that the metallic ring is imparted to the tone, and through the smiling position of the mouth that brightness and grace is lent to it, and this smiling position of the mouth at the same time gives an agreeable expression to the features. The position of the mouth here described is correct according to the rules of art: the old Italian school made it one of its axioms, and the best singing-schools of all countries have adopted it.

ON TONE-FORMATION, AND THE DIFFERENT MODES OF ATTACK.

A beautiful tone—I mean a tone fit for artistic purposes—must be free from all faulty sounds, and must therefore not have a guttural, palatal, nasal, noisy, or

uncertain quality. Every note must ring out by itself, independent and clear, and should never be pushed or forced.

The old Italian masters used the phrase, "*filare il tuono*" (to spin the tone). Just as the spinner draws the thread off the spindle, so must the singer take or draw off the tone softly and carefully, and never force the air against the vocal chords. If the voice is exercised in a natural and artistic way, it will remain fresh, soft, and flexible for a very long time; and therefore the Italians used the phrase, "*la voce ha buona pasta*" (the voice is paste-like)—meaning, that just as from a good soft paste one can evolve every plastic form, so can a singer with a soft and flexible voice give form and life to his representation of every vocal style.

We have three different modes of attack, but it is advisable to begin with one of these, the soft attack, and only later should the pupil exercise the other modes.

All vocal studies should begin with the improvement of the middle notes—those notes which everybody has received from nature, and which every one uses in conversation.

All voices should begin on the vowel *a* (ah), *chiaro-oscuro*. In voices where the middle notes are too dark, it is advisable to let them sing the vowel *a* (ah) first *chiaro* and later on *chiaro-oscuro*. The vowel "ah" remains for ever the best foundation, the primary basis of all tone culture. A fine and pure tone

can thus be best produced, as all parts of the vocal apparatus are, while that vowel is being produced, in a natural, easy, and unconstrained condition. The voice sounds on *a* (ah) fullest and most sonorous, because the tone-waves can move freely and easily. One should try to keep the tongue flat and quiet, and the soft palate raised. It is quite understood that we must also practise the other vowels; but we should always begin our studies on *a* (ah), because all faults and defects of sound are observed best on this vowel.

The air must strike the hard roof of the mouth (the hard palate) above the teeth, as all notes should be formed in the front of the mouth.

The old Italian masters said, "*Bisogna cantare sul fior della labra*"—"One must form the tone at the edge of the lips," by which they meant that the tone should never be formed in the back, but always in the front of the mouth. Formed in this way, the tone even in *piano* commands a greater range of distance. The principal singing-schools of France have also adopted this method, and they say, "*Il faut avoir la voix sur le bout des lèvres.*" As a proof, I mention only the great artists Faure, Lasalle, and De Reszke. Every country must adopt this method that wishes to cultivate artistic singing.

The theory of attack was first introduced by Pistochi (born 1659), and developed by the school of Bernacchi (born 1690, died 1759) at Bologna. His pupils afterwards propagated his method. Caselli, one of his

latest pupils, taught this theory to the Court singer of Saxony, Johannes Miksch, who in his turn gave instructions to the celebrated Wilhelmina Schröder Devrient, Agnese Schebest, and the well-known teachers of singing, Mannstein, Sieber, &c., who have rendered great services to vocal art.

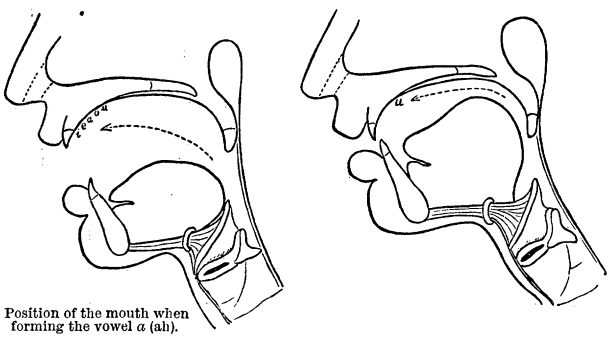
Natural philosophy teaches us, indeed, that a sound extends equally in all directions in the atmosphere; but this is the case only if the air is quiet. From Acoustics we know, p. 10, that the transmission of a sound is especially affected by the wind. In singing, we observe also that the air is set in motion, and the old theory of attack must therefore still be taught.

In the vowels *o* and *u*, the air takes a somewhat higher direction; in the vowels *i* and *e*, on the other hand, the air is directed somewhat nearer to the teeth. In other words: for the dark *timbre* the air is directed to the higher parts of the hard palate; for the clear *timbre* it is directed forwards, more towards the teeth. The method of attack is at the foundation of tone-formation, and on it depend all the conditions of beautiful tone; we should therefore regard it as the centre of the whole *technique* of singing, around which are grouped the different variations, "as in a drama the subordinate actors surround the hero."

When the pupil has acquired the right attack on "ah," he will have no difficulty in directing the air for *o* and *u* somewhat higher, for *i* and *e* a little deeper.

I give a diagram to show the directions of the air in

the production of the different vowels. We see that in singing *i* with clear *timbre,* the air is directed lowest; then follows *e, a, o,* and *u.*



Position of the mouth when forming the vowel *a* (ah).

The different positions of the larynx which are associated with the different vowel-sounds—*e.g.,* highest for *i* (ee), lowest for *u* (oo)—contribute materially to this result. We have sometimes to darken the clear vowels, especially in compositions like "Der Doppelgänger" by Schubert, or "Im Herbst" by Robert Franz, &c. Such sad melancholy compositions must be sung in a gloomy manner; and even in declaiming or speaking such poems, we would be compelled to darken the vowels. The direction of the air would then be a little altered.

If the air is not concentrated and not carefully brought forward, or does not strike the hard roof of the mouth, but, on the contrary, is divided in the mouth, and partly directed against the soft palate, the nose, or the pharyngeal walls, then we perceive the faulty guttural, nasal, and palatal sounds. In Reichert

and Du Bois Reymond's 'Physiologischen Archiv,' 1869, Professor G. Engel wrote an excellent article on this subject, which every teacher should read carefully.

The art of attacking a note properly is to some individuals very easy; to others, again, it is very difficult: it depends on the formation and the whole structure of the organs used during singing. A singer with a favourably constructed voice-apparatus will have less difficulty than one with a faulty apparatus. A thick tongue, a long uvula, a less arched palate, makes it more difficult to produce a fine tone. But through careful study the student may acquire the power of governing the air, and can learn to concentrate and direct it in such a way that it will on all vowels strike at the right place, and never go astray. The right attack will in time become the pupil's second nature, so that in performing he will no longer think how to direct the air, and how to produce a pure tone; he will be only inspired and animated by the poet's and composer's high ideas, his soul will be full of celestial fire, and then he will sing with poetic rapture, with liveliness of imagination, and with enthusiasm.

On page 145 the student will find an exercise which is to be practised daily with great attention to the different modes of attack. (See also 'Daily Vocal Exercises,' A. B. Bach: Metzler & Co., London; and Gutmann, Vienna.) Three different modes of attack were taught in the old Italian schools, and these have been adopted also by the masters of the more modern Italian schools.

The principal German and French schools, too, cultivate these three modes of attack, the grounds for their distinction having been established scientifically by German *savants*. These determine the three modes, according as the glottis is either completely closed, or partly closed, or completely open previous to the act of forming the note.

A note may be attacked in the following ways:—

(*a*) It may be given well marked, vigorously, and with determination, as if with a blow (*coup de la glotte*): this is effected by the perfect closure of the glottis previous to the act of forming the note, and the instantaneous opening and vibrating of the glottis in that act. The glottis being suddenly opened, the vocal chords are caused to vibrate to the extent required for the production of the intended note. This mode of attack is called *kehlschlag* (*coup de la glotte*). Even in the use of this mode of attack, one must not force the air against the vocal chords, but should only cause a relatively larger and concentrated amount of it to issue forth, the whole volume of which is to be put into sounding vibration, and none allowed to escape as waste air.

(*b*) The second mode of attack is the breathed or aspirated one, somewhat like the sounding of the Greek vowel with the spiritus asper (ʽ), or like an *h* prefixed to the vowel. This aspirate attack is effected by the perfect opening of the glottis previous to the formation of the note, and by its assuming the shape demanded for the production of the note only during the issue of

the air from the lungs. This mode of attack may be employed by voices of every class, but especially by tenors and high sopranos. It is used chiefly in falsetto; but it may also be resorted to with great effect in singing chest-notes, if the character of the piece to be sung admits of its application.

(*c*) The third mode of attack is the one employed in *messa di voce.* Here the attack is effected neither by the instantaneous opening of the glottis, nor by the sudden and powerful expulsion of the air, but by the glottis having assumed the shape requisite for the formation of the note a moment before the air begins to issue gently from the lungs. The notes are started very softly and delicately, and are sung in a gradual *crescendo.* This third method is called the soft attack. The singer has to practise all these three modes of attack,—for in rendering a slumber-song, he must not sing with a firm and marked attack; nor must he employ the aspirate one when he wishes to give full effect to a martial melody.

ANNOYING ACCESSORY SOUNDS.

These arise from a diversion, at some point, of the tone from its proper and direct course, whereby it is deteriorated and marred in its beauty. The commonest of these accessory sounds are designated from the region at which the tone is diverted from its course; thus we have nasal, guttural, and palatal tone.

Nasal sounds arise from the insufficient elevation of the soft palate and uvula, and the consequent imperfect closure of the choanæ (internal nasal cavities), by which imperfect closure a part of the air is allowed to escape through the nose: a nasal sound may also arise from an undue elevation of the tongue towards its root, by which the tone is diverted into the nasal cavities. This fault is best cured by executing before a looking-glass, and with a moderately open position of the mouth, the operation of raising the soft palate, and at the same time maintaining a level position of the tongue, so that it gently touches the lower teeth. Subsequent to this exercise, which may be repeated before the glass a few times daily, let the syllable *di di di* be sung from ten to twenty times on notes of the middle register. We choose this syllable because the consonant *d* promotes a forward direction of the tongue, and the *i* (ee) induces the most effective raising of the soft palate.

Guttural sounds have two causes; either the windpipe is pressed and strained by forcing the breath and using it too violently, or the epiglottis is not sufficiently raised, owing to which the tone rebounds from it, and is thrown back into the windpipe. In most cases an unsteady position of the tongue or an insufficient restraining of the breath creates the mischief. The guttural sound very often occurs with singers possessing a low voice, when they are anxious to give particular power to their lowest notes, and they imagine they can effect this by an unnatural depression of the

larynx; this, however, produces a contraction and compression of the throat, which deprives the tone of all beauty and freedom. Though the low notes may thereby gain in power and depth, the tone will always be unlovely, and will remind one of the lowing of certain domestic animals. Besides, this unnatural forcing of tone in a short time affects and spoils the notes of the middle register, and ultimately the higher notes also.

A guttural sound arises also in the production of high notes, when the epiglottis too closely approaches the windpipe, so that it deadens the tone at its very formation, and prevents its forward progress. This mostly occurs when the vowels are not taken open enough, and the fault is only to be remedied by giving the tongue as much as possible a forward direction, by which the raising of the epiglottis is promoted, especially if, instead of the close or obscure *timbre*, one more of the nature of *chiaro* is adopted. It is further very conducive to the purity of sound to sing exercises on words like glad, sad, &c.; as it will be remembered, from the chapter treating of the anatomy of the larynx, that the epiglottis is raised highest in the production of the vowel *ä*, and that it is only in this position that it permits the vocal chords to be seen in their entire length. An unnatural position of the head likewise mars the tone, and bending unduly forward is apt to make the notes sound as if squeezed out.

The old Italian school held an incorrect management of the breath to be the cause of the guttural sound; yet

I think Garcia gives the truest explanation when he maintains that the epiglottis is too much depressed, and thus presses on the windpipe.

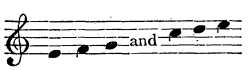
Palatal sounds arise from an upward arching of the tongue, by which the tone is diverted towards the soft palate, and is prevented from striking the proper part of the hard palate close above the teeth. Here, again, the want of a quiet position of the tongue is the cause of faulty tone; and the unpleasant palatal sound must here also be prevented by keeping the tongue in a level position, with its point gently touching the lower teeth, and thus allowing the concentrated jet of tone to strike the hard palate alone.

The palatal sound may also be occasioned by a sideward pressure of the tonsils on the larynx, which impedes the muscular action and free vibrations of the vocal chords; and this fault may be obviated by singing exercises alternately on *loo* and *loh*, by which the throat may be gradually widened. To understand the nature of this process, we should observe the following: too clear a *timbre* is apt to induce a squeezed sound, because it is connected with a contraction of the posterior cavity of the mouth, owing to the tonsils too closely approaching the larynx. In voices of every description, too clear a *timbre* is the result of an open position of the mouth and a contraction of the lower cavity of the throat. If, on the other hand, the aperture of the mouth is contracted and the cavity of the throat is extended, the obscure *timbre* is produced—as, for instance, on the

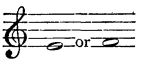
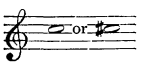
vowels *oo* and *oh*. A palatal enunciation makes singing an exertion, and soon fatigues even the most powerful voice; besides, it makes it absolutely impossible to pronounce the words with even moderate distinctness. But its worst consequence is the loss of the voice, after very few years. All unnatural muscular action impedes singing and ruins the voice. Only that method is correct which renders singing gradually more and more easy, and makes it a pleasure both to the singer and to those listening to him.

EQUALISATION OF THE REGISTERS OF CHILDREN'S VOICES.

In children's voices we observe two points where the so-called change or break of the voice occurs—namely,



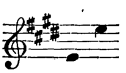
I subjoin a list of cases examined by me in Edinburgh and in Vienna (pp. 144-147), from which it appears that the break in children's voices virtually occurs at the points indicated above. Of course individual peculiarities occur, and an exact formula cannot therefore be given—least of all can it be asserted that the break should always occur on *f* or *g* only, for nature's dowry is as unlimited in the matter of vocal powers as in other things.

The chest-voice usually passes over to the so-called middle register on  and the passage from the middle register to a soft falsetto takes place on  when the scale is sung *piano.*

In the same manner as we are able to equalise the voices of men and women, we can obtain a complete equalisation of all notes within the compass of children's voices. The point fixed by nature for the break of the voice is called by the Italians *il ponticello* (the bridgelet). This little bridge will be crossed with comparative ease if care is taken that the naturally powerful notes of the voice be moderated, and, on the other hand, the feebler notes be gradually strengthened. In conducting the studies of children, one should endeavour to extend the natural limits of the one register of the voice, so as to make one or two of its notes reach into the adjoining register; for it is a great advantage to be able to employ either the chest or the falsetto voice on one or two given notes, in order that one and the same passage of a song may be delivered in either of the voices, in accordance with the character of the composition.

There is no better means for the equalisation of children's voices than confining them to *piano* singing at the beginning of their studies. I give exercises Nos. xxvii. and xxviii., *portamento,* as best suited for these studies, and would direct attention to the necessity of always singing the higher note in *falsetto.* Breath

is to be taken deeply and quietly before each exercise, and is to be renewed only when proceeding to the next exercise. Confining the child's voice to *piano* singing soon produces a very high degree of smoothness and equality of tone. If the falsetto voice is found in some voices not to answer readily, the exercises may be sung *piano* on the vowels *i* (ee), *ü* (like the French u), and *u* (oo), which will enable the child to reach Here, however, it is distinctly to be understood that the extending of the range of a child's voice can only be achieved where a natural capacity exists, and that it must be undertaken very gradually if it is to have any value at all.

Nature has fixed limits, which cannot be overstepped, be it by clever device or by the most rational instruction. The increasing of the range of the voice is to be undertaken only after the complete equalisation of the soprano octave,  and even then the range of the voice is to be increased only by a semitone, and this equally in the ascending and the descending scale, because the extension of the range in favour of one direction can only be effected at the expense of the opposite extremity. Accordingly, the following is to be sung after the equalisation of the soprano scale of *E* major has been effected:—

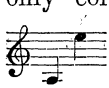
And so on.

In order to represent with proper effect the character peculiar to each, the soprano demands the clear *timbre*, and the alto the medium, clear, or obscure *timbre*; for it is by the *timbre* that the character of a voice is distinguished, and hence each voice is, even in the simplest exercises, to display its true nature: while the soprano, therefore, should take the *a* as pronounced in *far*, the alto should take it as in *fall*.

If children are allowed to sing their higher notes *forte* before the voice is properly equalised, it will become hard, harsh, and hoarse, and they will fail in correct intonation. A mistake in this direction not only ruins the middle register, but destroys the voice altogether. The consequence of encouraging *forte* singing is to change a soprano rapidly to an alto; and they will generally sing alto equally *forte*, because their vocal chords have lost their elasticity through overstraining, and the notes will no longer answer to *piano*. In a short time the alto, too, will be found to lose its few remaining notes, and then the excuse offered will be "the voice is breaking." I have examined the voices of large numbers of children who had been employed in church choirs, and have found such cases of loss of voice occurring as early as the eleventh year; and the conductor declared that the voice was breaking. This, however, is a great mistake, for in more northern countries the voice does not really break before the fourteenth, fifteenth, and even the sixteenth year. The

fact is that reckless singing often breaks tender voices, and breaks them for ever.

At the first, then, all notes are to be sung *piano* and with a gentle tone; subsequently the middle notes only are to be taken *piano*, and the falsetto somewhat more powerfully; and only later on, when the voice sounds quite softly, and when it is perfectly equalised, may the whole of the notes be practised in alternation *piano* and *mezzo-forte*. Songs, too, must first be practised *piano;* for if children are early accustomed to *piano* singing, they will never degenerate into shouting.

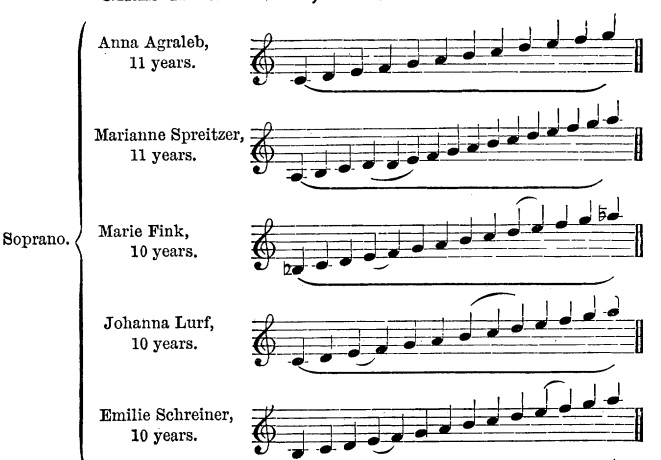
In young children brought up amid musical surroundings, I have but rarely observed a break of the voice. I was struck with this fact, especially in the case of young Hans von Haberer, whose father, Dr Theodor von Haberer, is a good vocalist, and particularly cultivates *piano* singing, while the mother, too, is very musical. The child, when only eight years of age, discovered, without any tuition, that it could reach with ease the high notes by singing *piano;* and I am certain that the father's example has unintentionally helped the child to find out this simple and only correct method. Young Haberer sings the notes  with perfect softness, and a break is nowhere to be detected.

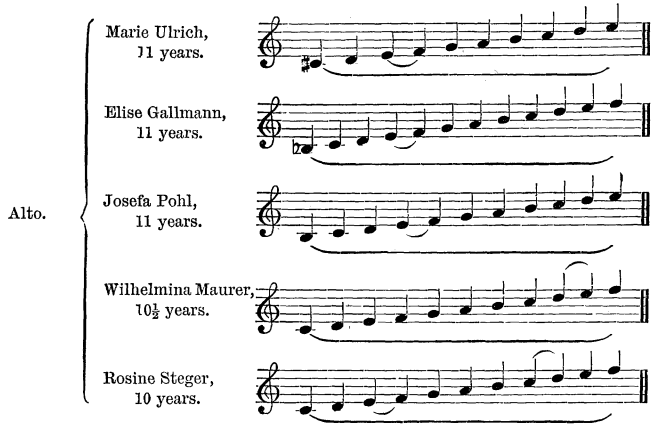
Previous to making children sing a song, the teacher should explain the words and then have them read with proper declamation; after this, the singing will be easier and more effective. The explanation of the

words will aid the child in intellectually appreciating them, and by this method one obtains not only a style of singing that produces an effect upon the hearers, but such singing will ennoble all the sentiments of the child. Instruction is to be offered to children in an animating and fascinating form, so that they may not feel wearied by it; but so as, on the contrary, to engage their entire attention. The celebrated Hufeland enumerates among the principal causes of curtailed life, the sense of tedium.

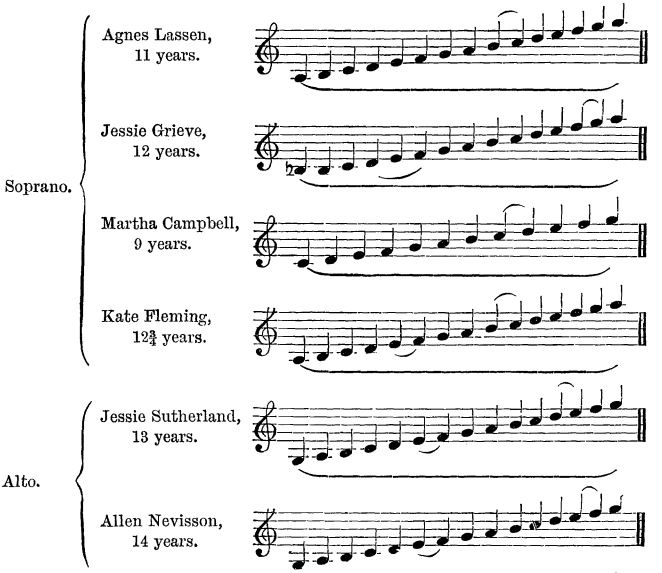
LIST of the GIRLS and BOYS whose voices I tried in Gloggnitz, near Vienna, and in Edinburgh. The ⌒ signifies the place where I noticed a change of register—a certain break in the voice.

GIRLS IN GLOGGNITZ, NEAR VIENNA—1884.



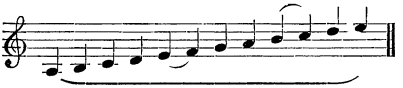


GIRLS IN EDINBURGH—1884.

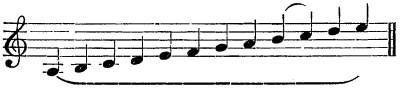


Alto.

Lizzie Latto, 10 years.



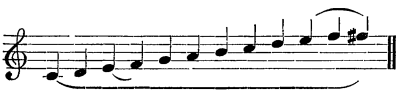
Alice Nevisson, 10½ years.



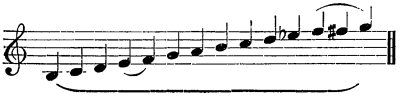
BOYS IN GLOGGNITZ, NEAR VIENNA—1884.

Soprano.

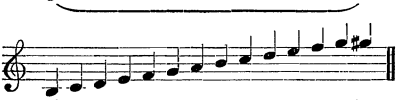
Emil Schorch, 8 years.



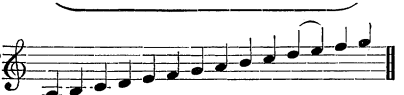
Mathias Hermann, 13 years.



Agosto Fondi, 9 years. (His father is an Italian.)

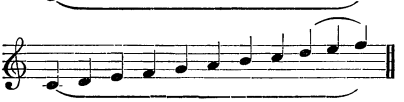


Theodor Drauschke, 9 years.

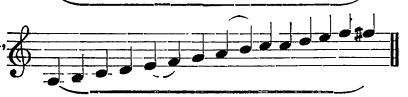


Alto.

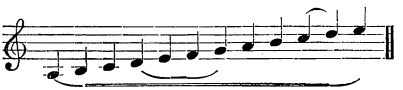
Carl Hermann, 8 years.



Franz Kreutenitsch, 13 years.



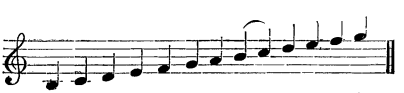
Rudolf Balloch, 14 years. (Voice already broken; the note *c* affected.)

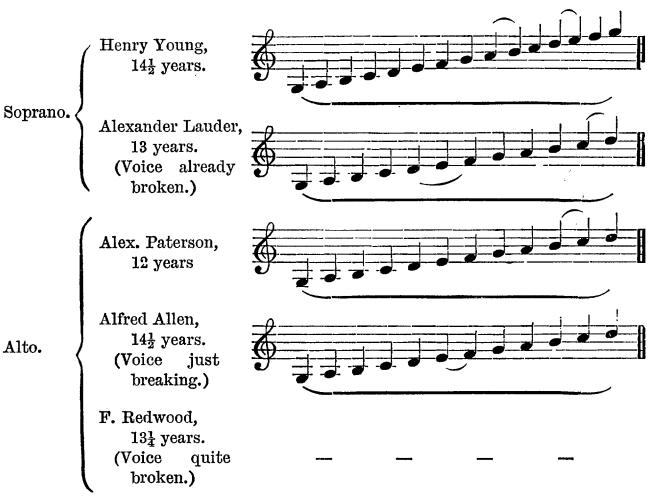


BOYS IN EDINBURGH—1884.

Soprano.

Thomas Burt, 12½ years.





MESSA DI VOCE; OR, FILARE IL TUONO.

In the theory of singing, *messa di voce* means the gradual *crescendo* and *decrescendo* of a note—the accomplishment of starting a tone in the softest *piano*, giving it more and more power up to the strongest *fortissimo*, and then, in the same breath, letting it gradually become softer and softer, until it dies away in a mere whisper. Control over the breath is the first requisite for the execution of an artistic *messa di voce*. "The beginning and the end of the note must resemble the wafting of the evening breeze: one perceives its beginning without being able to define it; one is still listen-

ing to its termination when the note has already died away."

We shall first discuss the transition from *piano* to *forte*. The vocal chords in a state of tension emit a note with even the most delicate breath, and this note *pianissimo*. If one wished to sustain that note *pianissimo*, neither the force of the breathing nor the tension of the vocal chords ought to be altered. We know that an increased tension of the vocal chords does not make the note stronger, but only raises its pitch. On the other hand, a note gains in power by an increased pressure of the air; but since a note may be raised in pitch solely by an increased supply of breath, even with an unaltered tension of the vocal chords, some remedy must be applied lest the increased force of breath should heighten the note, and this remedy lies in the relaxing of the vocal chords, which is effected by a slight upward motion of the thyroid cartilage, produced by a slight relaxation of the muscles of the cricoid and thyroid cartilages. A note is accordingly rendered more powerful by an increased supply of breath, and yet is not raised, but remains of the same pitch, provided that the tension of the vocal chords is decreased in proportion to the increasing force of the breath. The force of breathing and the tension of the vocal chords thus stand in an inverse ratio to each other.

In a *crescendo* the supply of breath is increased, and along with this, the tension of the chords is decreased; but both must be done very gradually, and without any

break. The tendency of the note to become sharp, and thus false, is to be specially guarded against; a fault which would arise if the chords were not relaxed in a measure corresponding to the increase of breath, and if the note were not fixed upon in thought very determinately, and so sustained during its whole duration.

In *piano* we have the feeblest breath and the highest tension of the vocal chords for the given note. In *forte* we have the most powerful breath, yet the lowest tension of the chords for the given note. And the same is the case, though in opposite direction, in the *decrescendo;* the power of the breath is diminishing to its greatest softness, while there is a transition, on the other hand, from the greatest relaxation of the vocal chords to their highest degree of tension for the given note. Here, too, any break is to be most carefully avoided, both in the gradual alteration of the breathing, and in that of the tension of the vocal chords; and both processes must be effected with the greatest equality, and with uninterrupted flow.

Seeing that we can exercise an influence on our vocal organs by our intellectual appreciation of tone only, it is understood that in practising *messa di voce* a most decided fixing of the tone in thought must throughout, and for the entire duration of the note, accompany the performance, if it is to be pure and perfect. For it is an absolute condition that the singer should have each note he wishes to produce beforehand in his mind as an intelligent conception.

In the *crescendo* the singer is to increase gradually the cavity of the mouth, and in *decrescendo* he must gradually contract it. *Forte* singing demands a larger supply of breath, and consequently the enlarging of the cavity of the mouth, lest the tone should sound compressed; while, on the other hand, *piano* requires a smaller cavity of the mouth, lest the tone should become diffused and too feeble.

The old Italian school used to apply to *messa di voce* the expression *filare il tuono* (the spinning of the tone),—and distinguished in it the beginning, *formare;* the sustaining, *fermare;* and the ending of the note, *finire il tuono.* For the *formare il tuono* they made it a condition that the pupil should indeed mark the tone from the beginning with perfect distinctness and clearness, yet enveloped as if it were in a delicate breath, so as to make it sound softly, whereupon the note is to grow in power, yet strictly to maintain the *timbre* assumed in its first start, and so to reach the highest development of power, and to be sustained at that climax for a time (*fermare il tuono*), and then diminished as gradually in force as it had been increased in the *crescendo.* During this decreasing in power (*finire il tuono*) again, the note should strictly preserve the *timbre* and the pitch in which it started; and this latter accomplishment requires a great deal more attention and study than the mere increasing of the tone in the *formare,* because in the *decrescendo* the jet of tone is, especially if not firmly supported by

practice, very apt to leave its original pitch—to recede —and to assume a false palatal character. If, however, the singer knows how to keep up the note to its true pitch even in its dying stage, he will be able to make full use of the softness and richness acquired by the note in *formare* and *fermare*, and he will succeed in finishing the note pure and true in *pianissimo*. The *messa di voce* exercises are at first to be sung in two parts, as indicated in Nos. xx. and xxi.; after that they are to be sung in one breath. The practising should not, however, extend beyond five or ten minutes, and should be strictly confined to the notes most readily at the singer's command.

VOWELS AND CONSONANTS.

Song is the noblest union of speech and melody, and without a correct pronunciation and declamation it will always remain imperfect. When there are faults of pronunciation and indistinctness in the utterance of the words, the listener feels himself, instead of being roused in his deepest and purest feeling, more or less deprived of sympathetic impression. An actor will scarcely ever attain success, although possessed of the finest voice, if he has defective pronunciation and an incorrect articulation; and as little will a singer with the most powerful voice produce a great effect on his audience if he neglects pronunciation;

for singing is, properly speaking, declamation in musical form.

Consonants are the expositors of thought, vowels the expositors of emotion. The word appeals to the intellect; and the more distinctly and definitely it is heard in the tones of the singer, the more rapidly does it affect the intellect of the hearer. Ideas are imparted by words. Emotions, on the other hand, are communicated by the colouring of the tone employed in the uttering of the word—that is, by the *timbre* and proper management of the breath; and as the word appeals to man as a thinking being, the animated tone appeals to his feelings. But only that singer can possess a warm and animated tone who possesses true feeling, refinement, and culture: then his sentiments will awaken the sympathies of his hearers, and the more the singer himself is inspired by the ideas expressed in the words, the more also will his hearer be inspired by them. As we have already observed, it is imperative that the singer should fully comprehend the character of the poetry he has to interpret, for he can only give a true rendering by his tones of what he has himself truly realised, and the chief means at his command are *timbre* and the management of the breath.

What is actually sung is only vowels. Consonants, on the other hand, are but momentary accessories, and they mainly depend on the checking of the breath, whether such checking be produced by a particular action of the tongue or of the lips.

VOWELS.

The vowels of the human voice are sounds produced by the membranous "reeds" — that is, by the vocal chords, whose resonant tubes—to wit, the cavity of the mouth—may be shaped to varying width, length, and pitch, so as to intensify sometimes the one, sometimes the other, of the harmonics of the note sung. It is necessary that we should remember that the character of the different vowels can be imparted to one and the same note through changes in the resonance of the super-laryngeal tube—namely, the cavity of the mouth. Here it is the larynx that produces the given note with its harmonics; but the difference in the sound or *timbre* of the vowels on which that note is sung arises from the intensifying of one or other of the part-tones or harmonics, through the resonance of the cavity of the mouth. A note will resound loudly when it coincides with the pitch of that vowel for which the mouth happens to be shaped.

The pitch of a given vowel varies very considerably, even where the vowel itself is very slightly modified, as in various dialects of the same language, or where the *timbre* of the vowel is very slightly altered. On the other hand, the resonance is generally found to be the same in the voices of men, women, and children. Air must not enter the nasal cavities from the mouth during the formation of the vowels, for if it did, the sound would assume a nasal character. It is shut off

from those cavities by the raising of the soft palate, but this closure is least complete during the formation of the vowel *ah*, and next to this in succession, *e* (eigh), *o* (oh), *u* (oo), and *i* (ee).

In forming the vowel *ah*, we perceive the unhindered passing of the current of air into the cavity of the mouth, and it is on this *vowel*, or, let us say, *fundamental sound*, that we can form notes with greatest ease. It is by this vowel, indeed, that even the infant expresses all its emotions; and it requires but little attention to enable us to recognise whether the *timbre* of that *ah* indicates a good or a bad humour.

The old masters were very wise in initiating all studies on formation of tone with this vowel *ah*, seeing that in the practice of every art we must commence with the easiest element. It is also on this vowel that any incipient, faulty formation of tone is most easily detected. The largest number of shades (*nuances*) of *timbre* can be effected on *ah*, which might well be called the father of vowels.

The vowel *e* (eigh) is less favourable to the formation of tone, for in producing it, the body of the tongue is somewhat arched in an upward direction towards the palate, and by this the outward passage for the breath is somewhat contracted. But if one endeavours as much as possible, in practising this vowel, to enunciate it gently, and to bring the tongue as much as possible forward, the formation of tone will offer little difficulty.

In forming the vowel *o* (oh), the lips approach each

other much more closely than in the formation of *ah*, and the tongue assumes a concave form, especially in its anterior part, which is strongly bent downwards. The aperture of the mouth is contracted; its cavity, however, is even more enlarged than in the formation of the *ah*.

In forming the vowel *i* (ee) the tongue is most strongly arched, and almost touches the upper palate, so that there is but a very limited space for the advance of the waves of sound. The tension of the lips reaches the highest degree; the lower and upper teeth approach even more than in the *e* (eigh). The larynx assumes its highest position on the vowel *i* (ee).

In forming the *u* (oo), the back of the tongue arches upward, whilst the point recedes from the teeth so as to make the pharyngeal cavity very capacious, and the cavity of the mouth as close and round as possible. The space between the tongue-bone and the larynx becomes wider; yet for the formation of a musical tone, *u* (oo) is the least favourable vowel, because the lips approach each other so decidedly that the mouth is almost entirely closed, and the tone is thus rendered dull. Beginners, who rarely open the mouth sufficiently, must therefore make their first studies on *a* (ah), *e* (eigh), *o* (oh), and *i* (ee), and only when they can form these vowels with ease should they attempt to practise on *u* (oo). This vowel also requires to be more sustained in singing and declaiming than *i* (ee). Its lower harmonics have fewer, and consequently

slower, undulations, and they demand a more prolonged resonance than is requisite with the high harmonics of *i* (ee).

On account of the favourable conditions which the tonic *b* flat offers to the ear, and on account of its numerous harmonics, the vowel *a* (ah) is heard at a much greater distance than any other vowel. In experiments instituted by Dr Oscar Wolf in an avenue in the open air one afternoon, he found that *a* (ah) can be clearly heard and distinguished from other vowels even at a distance of 360 paces;

o (oh) . . . . at a distance of 350 paces;
ei (i, much the same as ai), at a distance of 340 paces;
e (eigh) . . . at a distance of 330 paces;
i (ee) . . . . at a distance of 300 paces;
eu (oi) . . . at a distance of 290 paces;
au (like *ou* in *house*) . at a distance of 285 paces;
u (oo) . . . . at a distance of 280 paces.

The above shows that of all the vowels *u* (oo) makes the feeblest impression on the ear, and, in fact, is only heard up to the distance of 280 paces. This is owing to *u* (oo) being the vowel that has the fewest harmonics, and that answers to the low pitch of *f*, which tells but little upon the ear. It is the dullest vowel, and the most destitute of sound.

We certainly cannot sing everything on the vowel *a* (ah), and therefore have to endeavour to meet and to overcome the difficulties in the formation of the vowels, even where, as in the case of *u* (oo), the vowel may be unfavourable.

Thus the singer should endeavour, when singing *i* (ee) and *e* (eigh), to keep the teeth as much as possible apart; and again in singing *o* (oh) and *u* (oo), he should resist as much as possible the tendency to close the lips.

Taking *a* (ah) as the standard vowel, we may derive from it two main branches of vowel-sounds—the clear and the obscure. Following the line from *a* (ah) towards *e* (eigh) and *i* (ee), we obtain the clear *timbre;* and taking that towards *o* (oh) and *u* (oo), we get the obscure *timbre.* Words expressing a pensive mood demand the obscure *timbre,* whilst a joyful frame of mind demands a clear treatment of the vowel.

The vowels *i* (ee) and *u* (oo) mark the limits, the first of clear and the latter of obscure vocalisation.

In *forte* singing the vowels must not be taken too close—that is, *e* (eigh) should approach the sound *a* in Mary, *i* (ee) that of *e* (eigh), *o* (oh) that of *a* (ah), *u* (oo) that of *o* (oh), and *a* (ah) itself should be taken medium (clear), and, if sung on a high note, rather more obscure.

Falsetto answers readiest and easiest on the vowels requiring a contraction of the cavity of the mouth—to wit, on *u* (oo) and *i* (ee). The full chest-voice adapts itself best to *a* (ah), and successively to *e* (eigh) and *o* (oh).

Even Tosi gives the advice that voices which have a difficulty in producing the falsetto should be exercised on the vowel *i* (ee). Mozart, who, even when yet a child, applied himself to the study of the voice, assigns

in his "Nozze di Figaro" to the bass voice, in the aria "Se vuol ballare, Signor Contino," the high *f′* to the vowel *i* (ee); and this high note must be taken falsetto by a bass singer who wishes not to shout but to sing. Only thus can it be taken with ease and be sung naturally.

The thin vowels *i* (ee) and *e* (eigh) will be found of service in giving clearness and grace to voices either too languid or too voluminous; while, on the other hand, a taste for softness and richness of tone may be cultivated by practising on *o* (oh) and *u* (oo).

The sounds answering to the German so-called modified vowels (*ä, ö, ü*), which correspond to the French *ai, oui, u,* require precisely the same position of the mouth, lips, and teeth as the vowels *a, o, u* from which they are derived. The tongue, however, assumes in producing these modified vowels the same high and arched position as in producing the vowel *e* (eigh), although in a less degree than in the production of the purer vowel.

CONSONANTS.

In the formation of consonants three organs are chiefly concerned—the tongue, the soft palate, and the lips—because these organs have motion, while the palate and the teeth, being fixed, remain passive, and only affect the formation of the consonants when the tongue by its motions enters into a combination with them. We distinguish consonants as labial, dental, and

palatal, according to the parts where the sound is formed. The parts of the cavity of the mouth in which the consonants originate are always contracted into the so-called "*gates.*" The gate of the lips employed in forming the labials *p, b, f, v, m,* is formed either by both lips or by the under lip and the upper incisors. The gate of the tongue employed in forming the linguals *t, d, s* sharp, *s* soft, *l, n, r,* is formed by the tip of the tongue and the anterior part of the hard palate or the inner side of the upper incisors. The root of the tongue and the soft palate form the palatal gate for the palatals *k, g, ch, r* (the latter sounded in the throat). From the instantaneous forcing of these gates after their closure, or from the instantaneous closure after being opened, arise in each of these three gates the so-called explosive consonants—namely, *p, t,* and *k.*

If the opening or closing of the gates is not instantaneous but more gradual, another series of consonants —namely, *f, v, s, t, s* sharp, and *ch*—are produced; and if in this latter series the tongue co-operates, *v, s* soft, *l,* and *j* (like *y* in yes) are produced. If the gate remains closed so as to cause the current of breath to pass through the nose, *m* and *n* are formed; and if there is an alternate opening and closing of the gate during the passing out of the breath, *r* is formed, which is originated in either the tongue-gate or the palate-gate.

The faucal or throat *r* is not admissible in singing, and only the lingual form of this consonant is here available, in the production of which the tongue

vibrates against the hard palate. Another reason for using the lingual *r* is the resistance which the tongue offers to the outward passing of the current of breath. The tongue tends to obstruct the passage of the breath: the current of air, however, depresses the tongue, and thereby causes it to vibrate.

The consonants, as we have seen, arise from noises which are produced by the lips, the teeth, the tongue, and so on, and which accompany the beginning or the end of vowel-sounds. Even noises, however, are in a certain sense capable of definition. A noise is nothing other than a succession of simple sounds, which generally lie very close to one another in the scale, and which are in most cases subject to very rapid and irregular variation. But we always find in the noises accompanying the consonants one and the same succession of so-called simple sounds.

Dr Wolf, in his work 'Sprache und Ohr' (Vieweg: Braunschweig, 1878), determined the pitch of the consonants. He, in the first place, tried one evening, when everything around him was still, to produce the individual consonants in succession by themselves in a whisper. In the course of this experiment, it appeared that one series of consonants has a perfectly independent sound, whilst another series becomes audible as tones or sounds only when a vowel is sounded along with them. Those consonants which can be sounded perfectly pure and independent of vowels he calls self-sounding consonants: these are *r*, *b*, *k*, *j* (*y* in yes),

f, *s*, *g*, *sch* (like *sh*). *M*, *n*, *l*, and *w*, on the other hand, are not self-sounding, and can be uttered only with the aid of a vowel; while with the *h* so feeble a sound is emitted, that one cannot distinguish whether it is associated with some vowel-sound or not. He therefore calls the series, *h*, *l*, *m*, *n*, and *w*, sound-borrowing consonants, because they must always be accompanied by a preceding or succeeding vowel, else they will not become audible. For the sake of intelligibility, Dr Wolf retains the term consonant, notwithstanding that in the term self-sounding consonants a contradiction is involved.

Wolf has fixed the pitch of the self-sounding consonants by means of an acoustic apparatus for harmonics, constructed by Herr Georg Appunn.

Herr Appunn is said to be able to play readily any of the instruments used in an orchestra, and to possess a musical ear trained to a rare degree of perfection. His apparatus is constructed in the manner of a small harmonium, with reeds and valves pertaining to them, and it contains, inclusive of the tonic, the first 64 harmonics of the lowest *C*, equal to 32 vibrations in the second.

By means of this apparatus for harmonics and of the resonance-globes, Wolf and Appunn determined the pitch of the following consonants:—

Pitch of the consonant $b = e_{\text{I}}$.
" " $k = d^{\text{II}}$, d^{III}.
" " $t = f$ sharp$^{\text{II}}$, f sharp$^{\text{III}}$.
" " $f = a^{\text{II}}$, a^{III}.
" " $s = c^{\text{IV}}$, c^{V}.

They heard *sch* at a distance of 200 paces.
" *m* and *n* (combined with *a*) at a distance of 180 paces.
" *s* at a distance of 175 paces.
" *f* " 67 "
" *k* and *t* " 63 "
" *r* (produced by the tip of the tongue) at a distance of 41 paces.
" *b* at a distance of 18 paces.
" *h* (by itself as an intensified sound) at a distance of 12 paces.

In trying to produce the self-sounding consonants *b*, *k*, *t*, *f*, *s*, in succession, each independently, they will be found to possess harmonics, and it will also be found that an acoustic proportion, easily taken up by the ear, exists throughout their collective number. It will be at once perceived that in this succession the sound of *b* is the lowest and the sound of *s* the highest. Further reflection upon this phenomenon will show that the reason for this proportion must be sought in the different capacity of the resonating area of the cavity of the mouth required for the different consonants, and that this capacity is largest in the sound of *b*, and smallest in that of *s*.

From the foregoing statement it will be understood that the vowels have the greatest intensity of tone, and can be heard at the greatest distance—in fact, at a distance at which all consonants are completely inaudible; yet we also see that even between the individual consonants there occur very considerable differences in the degree of intensity.

The consonants are much poorer in harmonics, and

are, besides, accompanied by very high and discordant harmonics, which are in no manner fitted to intensify the tonic, but rather tend to weaken it. The consonants must be pronounced very distinctly and quickly; the energetic ones energetically, and the soft ones softly, thus—

G softly, but *k* energetically.
B „ *p* „
D „ *t* „

Each consonant, however, may be formed with a greater or less degree of intensity, according as the outward passing current of breath is forced or restrained. In dramatic song, the sounding of the consonant must, for the sake of expressiveness, be energetic; in lyrical passages, more soft and low. Thus, for instance, there is a difference in the sound of *g* in the word "go" when used in a kindly invitation, as "Go with me," and in the same word in an excited exclamation, as in "Go, insolent one!"

Consonants are, for two reasons, of great importance in singing. In the first place, if the consonants are indistinctly uttered it is impossible to understand the words of a song, and then, in consequence, the performance lacks intellectual animation. Secondly, the consonants are of great consequence in the formation of the voice, seeing that hard voices may be improved by practising on soft consonants, and *vice versâ*. *N*, *f*, and *m* are conducive to softness; the mute consonants *d*, *g*, *k*, *p*, *t*, are calculated to elicit energy. All

consonants may be treated softly or energetically, and thus one can lend to the vowels—that is, to the voice itself—either brilliancy and force or softness and tenderness; for the consonants belong to a sphere more external than that of the vowels, and they can therefore be more easily subjected to the control of the individual. *L* is a particularly efficient medium for pure intonation. The voice at once answers to *l*, and the jet of tone is, on account of the position of the tongue, carried of necessity through the mouth and not through the nose. Besides, the tongue, being firmly planted against the upper teeth, conducts the tone straight to the right place of impact, and the *a* (ah) succeeding the *l* is of itself guided thither. Lamperti, Varesi, Ronconi, and many other masters, prescribe daily exercising on *la, le, lo, li, lu.* Professor G. Engel recommends the following experiments for the purpose of assuring one's self of the manner in which even the vowels yield to the impulses initiated by the consonants:—

"You may," he says, "plant the tip of your tongue against the hard palate, as far as possible above the upper teeth, and in such a manner that the lower side of the tongue is raised to quite a perpendicular position in the mouth, and then sing *l* on any note you please. If you now let an *a* (ah) follow the *l*, you will, suppose you join the vowel to the consonant without the least constraint, observe that the *a* assumes a somewhat obscure *timbre.* On the other hand the *a* has a

clear sound, approaching that of *ai*, if the point of the tongue is placed against the upper teeth, or pushed between the teeth. And again, if the tongue rests above the upper teeth, a medium clear *a* is the result."

In this and similar ways we may avail ourselves of the natural efficacy of the consonants for the improvement of the student's style in forming the voice, and save him scientific disquisitions more or less unintelligible to him.

Let it be specially noticed that a consonant affects the tone *succeeding* it. This is so much the case, that if a singer were to produce all consonants with the utmost power and sharpness, the latter quality would also be imparted to the tone, and the voice would in a short time lose its richness, softness, and freshness. All exaggeration must therefore be avoided. Even exaggerated distinctness would become a fault. For if the attention is too much concentrated on distinctness of pronunciation, the singer is apt to cease to sing at all—*i.e.*, he is in danger of neglecting the principal thing, the formation of tone, singing itself.

All the consonants are to be taken with precision, though, where it is necessary, even the hard and energetic ones must be taken with a tendency to softness. In the same manner the vowels too must be started gently, and yet with the greatest decision and with an absolutely pure intonation. And when thus, in song, the energetic consonants are artistically combined with the soft vowels, "the rigid and the soft" will, as Schiller

has it in his 'Lay of the Bell,' be "united for good," and his words will become true :—

"Denn wo das Strenge mit dem Zarten
Wo Starkes sich und Mildes paarten,
Da giebt es einen guten Klang."

ON EQUALISATION OF VOICE.

STUDIES IN *PIANO* SINGING.

In all voices the middle register is the best, and admits the easiest of cultivation. The first object in the formation of tone, therefore, consists in the equalising of the middle register of the voice in all degrees of force. To attain this object, the tones of the middle register must, as a first study, be sung quite *piano*. Thus, let the pupil first sing three, then four, then six notes of the middle register, and then extend them gradually to nine notes, in the manner given in my exercises. From the beginning let the pupil sing on a fairly clear "ah" all the notes in slow time, and let him distribute his breath equally on these notes, so that each note is equally *piano*. The expiration must be effected without any straining or forcing, in a quiet flow, and the jet of tone should always strike the hard palate close above the teeth. We have noticed already that the jet of tone strikes the palate on the vowels *oo* and *o* somewhat higher, and on *ee* and *eh*

somewhat lower. In fairly clear tones, however, the portion of the palate struck by the tone lies just above the teeth, and it is with this *ah* that we have to commence.

After having sufficiently equalised the middle register by studies in *piano*, one or two higher notes and one or two lower notes may be added, and be sung softly with limited breath. Then one may progress cautiously to higher notes, and if the singer allows his breath to flow out equally with all moderation, the falsetto register will appear, so to speak, of itself. This falsetto will, in all voices, uniformly appear on that higher note, which, taken *piano*, no longer is given out by the chest-register, and in which, accordingly, a moderate measure of breath is no longer able to set the stretched vocal chords into vibrations throughout their entire extent. This note in *piano* singing at which falsetto sets in, is generally *b* in a bass voice, *d* in a baritone, *e* and *f* in a tenor, *b* or *c* in the alto, *e* flat or *e* in a soprano.

We repeat that the note marking the transition to the falsetto will, provided the breath is given out with equal moderation, appear quite naturally and of itself; and this gives us also the key to the way in which the singer can pass from the chest to the falsetto register. This key consists in nothing but the strict maintenance of a perfectly equal and very moderate breathing; or, in other words, in a perfectly equal *piano* scale. After having effected the connection

between chest and falsetto register on the vowel *ah*, the other vowels may be practised in succession. We will observe, even after limited practice, that all notes of a scale can be produced with equally limited breath, and that only the tension of the vocal chords will vary. On the varied tension of the vocal chords, then, depends the varying height and depth of the notes.

A note appears somewhat raised in pitch when the somewhat relaxed vocal chords are put in larger vibrations by a greater current of air. The tension of the vocal chords must therefore be relaxed in some degree when the note is sung *crescendo*, and must be increased again on singing it *decrescendo*. If the tension of the vocal chords were not increased in accordance with the decrease of the current of breath, the note must needs become a different and, in fact, a deeper one. We have always to bear in mind this inverse ratio between the action of the muscles of the chords and the action of the breath in our exercises, and especially so when we pass from *piano* to *mezzo-forte*.

We now pass over to the discussion of the method of producing a *mezzo-forte* scale.

MEZZO-FORTE STUDIES.

If we desire to produce *mezzo-forte*, any note—for instance, *c*—which we have been singing *piano*, the tension of the vocal chords must be somewhat relaxed, and the breath proportionately increased. If, farther,

the next note in the scale, *d*, is to be equal in force to the preceding *c*, we have to apply not only the same force of breath, but also the same ratio, in the relaxation of the tension of the vocal chords. The same ratio which was to be observed between the relaxation of the tension of the vocal chords and the force of the breath must take place again in singing the *d*. The production of each higher note depends on a farther tension of the vocal chords, and yet the quantity of breath may remain the same throughout the entire scale. In the singing of the scale in uniform *piano*, the limited supply of breath remains the same throughout, and the scale is actually produced by the successively increased tension of the vocal chords.

In singing *mezzo-forte*, the transition to the falsetto is somewhat more difficult than in the *piano* scale, for here the larger supply of breath that produces more powerful notes makes it possible to sing one or two notes in the chest-register which appeared as falsetto notes in *piano* singing. A bass voice whilst passing in *piano* singing to the falsetto on *b*, will, in singing *mezzo-forte*, only make the transition on *c* or *c* sharp. The transition, therefore, has been removed to a semitone or a tone higher. The transition to the falsetto will, however, be effected without much difficulty, if the singer maintains a steady position of the larynx, and strictly preserves the same limited supply of breath he has been using in the chest-voice, while at the same time he colours somewhat darker (*oscuro*) his vowels

previous to entering on the falsetto. The falsetto voice will then appear more powerful, and resemble in sound the chest-notes.

The equalisation of the chest and falsetto voice consists essentially in the greatest possible obliteration of the difference in *timbre* between chest and falsetto notes—or, in other words, in the avoidance of too massive and full a tone in the chest-notes, and too sharp and shrill a tone in the falsetto. This equalisation is effected by a suitable adjustment of the resonance of the cavity of the mouth, by change of *timbre*. The adoption of the *oscuro timbre* for the vowels preceding the falsetto, allows the latter to appear in greater power and richness; and, *vice versâ*, the *chiaro timbre* adopted for the falsetto makes the natural strength and fulness of the preceding chest-notes appear less obtrusive. The rule to be adopted, therefore, for proper equalisation of the two registers, is to sing the ascending scale in *oscuro timbre*, and the descending in the *chiaro*. In the treatment of voices that have been spoiled by a bad method, and whose falsetto does not come forth with ease, it is advisable to employ in singing the vowels *oo* and *ee;* and farther, not to allow the pupil to follow up his highest chest-notes with his first note in the falsetto, but to make him take after his highest chest-note a falsetto note lying two or three tones above it, because such higher notes in the falsetto are much more easy to start, especially on the vowels *oo* and *ee*, than the lower ones. While in

the chest-register a decided marked starting of the notes would naturally suggest itself, the falsetto voice lends itself much more readily to a gentle breath. Accordingly, it is advisable that the singer should endeavour to start even his chest-notes with a gentle breath, in order to deprive them of their natural firmness and hardness, and to make them and his falsetto notes more equal. Later on, the falsetto notes, too, may be taken also with a more decided energetic start, in order to develop every kind of starting in all the registers. As to the word register, I should like to abolish its use in the theory of singing, since it is apt to lead to misunderstanding. The object in the formation of voice is simply the equalisation of the different voices (chest and falsetto); and this, as said before, is best effected by studies in *piano* singing. In altos and mezzo-sopranos there occur two points in the scale at which the *timbre* perceptibly changes,—namely, in altos on *e′* or *f′*, and again on *b″* or *c″*; and in sopranos a tone above these. In the equalisation of these points, the rules stated above are again to be strictly observed.

We now proceed to the method of producing an equalised *forte* scale.

FORTE.

We have seen that in the production of a *mezzo-forte* tone the supply of breath had to be increased, and, on the other hand, the tension of the vocal chords had to be relaxed; and this operation must likewise take place,

and that in a higher degree, in the production of a *forte* note. Here the oscillations produced in the still more relaxed vocal chords by the more powerful current of breath are much wider, and they are still wider in the *fortissimo*, because here the breath attacks the more relaxed vocal chords in the greatest possible volume. The proportionate relaxation of the muscles of the vocal chords is here in a much larger ratio to the increased force of the breath than it is in the *mezzo-forte* scale. If a note is not to become higher in the *forte*, the tension of the vocal chords must be somewhat more reduced than was necessary in the production of *mezzo-forte* notes, because the breath has to furnish compensation for more relaxation than in the *mezzo-forte*.

The transition from *forte* chest-notes to the falsetto is more difficult than in the *mezzo-forte*, and it would therefore be very unwise in a student to commence his equalisation studies in the *forte*. Unfortunately, however, the number of those who see their success only in *forte* singing is very large; and the only means to improve their singing is to induce them to sing their high chest-notes *mezzo-forte*, and thereafter *piano*, until they become convinced that it is through *piano* singing that the voice is to be equalised in the quickest and most natural manner.

If once the singer has mastered a fine artistic falsetto, the next exercise should be to start a note in the falsetto, and make it pass into a chest-note, and again to effect its return to falsetto. The conditions under

which this can be done are the same as in *messa di voce* (*crescendo* and *decrescendo*). Let, for instance, *C* sharp be started in falsetto *pianissimo*, and be gradually increased. Even in passing from *pianissimo* to *piano*, the tension of the vocal chords may be reduced (on reaching *piano*); and as these chords relax, the breath must be increased.

At the point of transition from *piano* to *forte*, and at the moment when more force is being given to the breath, the vocal chords must be somewhat relaxed, and thus the chest-note is produced—that is to say, the same note, at the starting of which, with the softest breath, only the edges of the lightly stretched vocal chords vibrated (falsetto), becomes a chest-note at the moment when the somewhat relaxed vocal chords begin wholly to vibrate under the influence of the increased current of air.

In the same manner, the singer may go back again from a *forte* to a *mezzo-forte* chest-note. This is effected by a somewhat greater tension of the vocal chords, and a simultaneous diminution of the breath; and if by these means the proper tone—namely, *C* sharp *piano*—has been obtained, then the tension of the chords may be still further increased, and the note be sung falsetto, with the faintest current of air, and, as it were, only softly breathing it.

The transition from falsetto to chest notes, and *vice versâ*, has always to be effected with very moderate breath, and *piano;* with a strong breath the transition

is not possible, and the whole process depends, accordingly, on our ascertaining for each note on which the transition may have to be effected, the lowest measure of breath by which the note can be produced as a chest-note. The falsetto note, possessing rather more power than the *piano* chest-note, will with greater readiness merge into the chest-note. In passing from the chest to the falsetto note, breath should not be inhaled. The proximate notes—that is, the notes lying nearest (either above or below) the break of the voice—have to be produced by either method. This is the most correct means for bridging over the break between chest and falsetto, and upon this rests the entire science of the equalisation and assimilation of the registers. The compass of the falsetto notes should be somewhat extended in descending, and that of the chest-notes be similarly extended in ascending passages. As a matter of course all straining must be avoided. The *voix mixte* is an intimate blending of the *timbres* of the two forms of chest and falsetto notes.

RULES FOR BREATHING IN SINGING AND MUSICAL DECLAMATION.

In speech, when an orator speaks with feeling, certain parts are distinguished from the rest by suitable inflections of the voice, and the sense of the words spoken is thus more powerfully impressed upon the hearer.

So also in the rendering of a melody, those parts, notes, and successions of notes, by which the emotion is chiefly to be represented, must receive suitable emphasis, or, in other words, they must be particularly accentuated. The different signs at the disposal of the composer for marking such accents are very limited, and of too general a character, because the intellectual drift of a composition can only be very imperfectly indicated by merely mechanical signs. The singer, therefore, has to rely more on his own musical feeling than on the suggestions of the composer.

In order to find the true accents for his rendering, the singer ought, in the first place, to study very carefully the words of his song; and to impress upon himself their intellectual significance, he must recite the poem correctly. Only when this has been done, may he begin to study the musical part and its vocal requirements.

Formally correct recitation or declamation requires the proper treatment of the accented and unaccented syllables in the melody, so that the musical accent may coincide with the rhetorically accented word or its principal syllable, and so that the unaccented syllables may have their true secondary value.

In song two arts combine, music and poetry. The singer, therefore, has to do justice both to the composer and to the poet; and it would be a fault in singing to attend mainly to beautiful formation of tone, and to neglect entirely the enunciation of the words. From

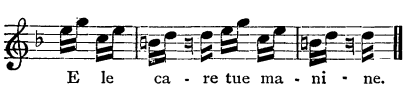
tones alone he could receive only indefinite and obscure notions, and it is only by due attention both to the words and tones that vocal music can receive a clear interpretation.

I would give here the following directions:—

I. Let the performer, in singing, breathe, as far as possible, as he has to do in correct recitation. One breath ought to cover as many words as are required to express a complete idea. A singer should only take breath where the musical and declamatory clauses permit, and for this purpose he must always economise the breath at his disposal.

II. Breath is to be taken at every one of the longer rests.

III. When a number of shorter rests interrupt the individual syllables of the text, as, for instance, in Zerlina's air in Mozart's "Don Giovanni" (Batti, batti, o bel Masetto),



the singer is to interrupt the *cantilina*, without, however, taking breath.

IV. In songs which require frequent breathing, the singer must endeavour to make the *mezzi respiri*—that is, intervening breathings—calmly and inaudibly.

V. One must never breathe at the beginning of a bar, which is not preceded by a rest.

VI. In order to avoid mechanical rhythm (such as is

found, for instance, in the strokes of an engine) and to promote the flow of melody, one must in common time breathe on the 2d and 4th crotchets, and never at the beginning or middle of the bar.

VII. What has been said of common time applies also to $\frac{2}{4}$ time.

VIII. In $\frac{3}{4}$ or $\frac{3}{8}$ time one must only breathe before the last crotchet or quaver.

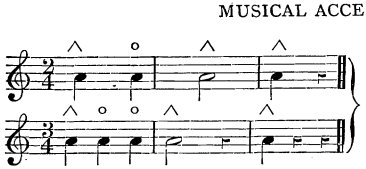
IX. In $\frac{6}{8}$ time breathe after the second and fifth quavers.

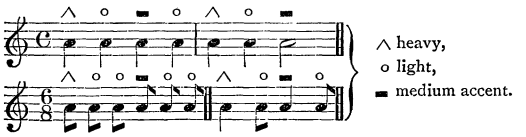
X. With the individual notes of quaver triplets the same rule is to be observed as with $\frac{3}{8}$ time.

XI. With four semiquavers representing a crotchet, the same rule is observed as with the four crotchets in common time.

The notes as constituents of the bar are sometimes classified into good and bad ones. Good is, in $\frac{2}{4}$ time, the first crotchet, and bad the second; then, in $\frac{3}{4}$ as well as in $\frac{3}{8}$ time, the first note is good, the second less so, and the third bad. In common time the first and third crotchets are good, and the second and fourth bad; the third again is less good than the first, and the fourth worse than the second.

MUSICAL ACCENTS.





XII. Breath is to be taken before the word represented by a note of considerable length, if a run is joined to the note.

XIII. If the singer is not able, for want of physical power, to sing in one breath such cadences written by the composer as are to be met with in Bellini's and Rossini's works, the *cadenza* should be abridged rather than broken up by taking breath. Care must of course be taken to round off well, and to maintain the musical character of the *cadenza*, notwithstanding this abridgment.

XIV. The time for breathing must, where no rest is marked, always be taken from the value of the preceding and never from that of the next note; because by taking it from the latter, precision in starting it could not be obtained, and time could not be properly maintained.

XV. In *passagen*, breath is best taken at places where an ascending succession of notes is suddenly interrupted by a low note, or where a descending succession is interrupted by a high note.

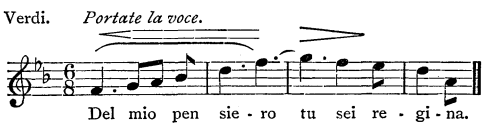
XVI. Turns must never be separated by breathing from the principal note to which they belong.

XVII. Breath, when needed, must be taken at a

comma, and also before the preposition introducing a prepositional clause.

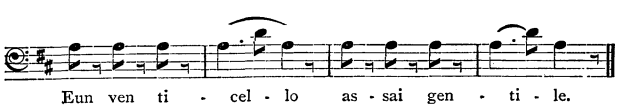
XVIII. In *portamento di voce* breath must never be taken, as doing so would destroy the melody.

In the following phrase the composer writes "*portate la voce*"—



Should a vocalist not have sufficient breath on the high *g*, he may take a breath before that note, and will produce a good effect if he sings the following notes *legato* and *mezzo-forte;* but he should not take a breath before as in doing so he would spoil the whole phrase.

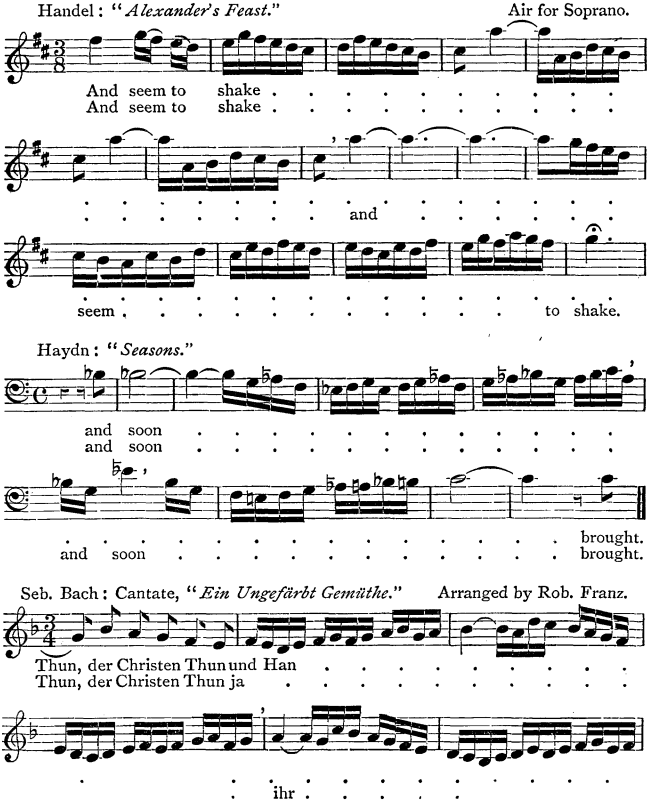
XIX The syllables of a word must not be separated by breathing, except where necessity demands—as, for example, in Rossini's "Il Barbiere di Seviglia," La Calunnia in the part of Basilio.

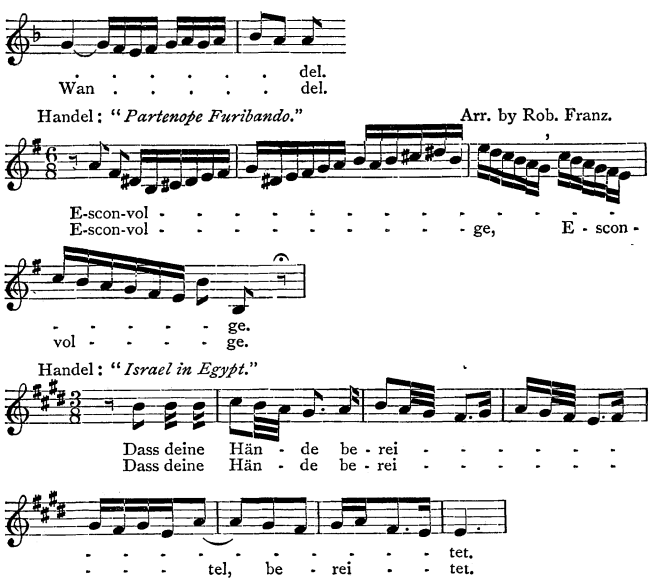


In passages like this, the separation is quite characteristic.

XX. In many of the airs of Bach, Händel, and Haydn, in which long passages of notes are apportioned to one syllable, it is permitted to alter the word or

words of the text, because it is not every singer who possesses the power or the skill to sing passages of from fifteen to twenty seconds' duration in one breath without getting exhausted. It is understood that the alteration of the words of the text must not affect its sense. The following examples may serve to illustrate this rule:—





XXI. Italians often employ a mode of breathing which they call *furberia del canto*—that is, humming in singing. This mode of breathing consists in the singer taking breath where no one suspects it. For the practice of this expedient, no binding rule can be laid down; for in *furberia del canto* the singer often takes breath even between words closely connected with each other, though his chest is still filled with air, in order to create an impression that he is labouring under strong emotion. This effective trick often affords a means for picturing suppressed excitement.

In following out the above rules, the individuality of

the pupil must constantly be taken into account, seeing that, especially with beginners, physical necessity will assert itself to the prejudice of any rule.

It is the composer's duty to know and to respect the conditions of breathing imposed upon the singer, and also to take into account the logical connection and the metrical structure of the words of the text, so that he may render the taking of breath possible throughout, according to necessity and to the sense of the words.

The composers of more recent date will, as a rule, be found to write their compositions with due regard to the coincidence of musical and declamatory breathing, because they are accustomed first of all to study the words with great care; and we are glad to observe this in the works of Schubert, Schumann, Wagner, Robert Franz, Brahms, and others. The masters of the old school were less concerned about the words or requirements of the text.

It is quite impossible to prescribe all the rules for musical and declamatory breathing to be applied in singing; supported by sound tuition, however, the intelligent pupil will, by attending to the rules given above, be able of himself to supply any additional maxim, and to employ it suitably.

VOCAL EXERCISES

VOCAL EXERCISES.

GENERAL RULES AND INSTRUCTIONS.

THE student should sing the following Vocal Exercises only when both body and mind are perfectly at rest. He should never sing immediately after any sustained physical or mental exertion, nor immediately after a meal. He should stand in singing, because sitting impedes diaphragmatic breathing, and compels the singer to breathe too frequently, too superficially, and too irregularly. When singing, the student must avoid leaning against a table, chair, or any other solid object. He should stand perfectly quiet, without any constraint, and in the most natural position. Chest and throat must have perfect freedom of action: tightly fitting clothes hinder the expansion of the chest; tight collars interfere with the free play of the larynx.

All the vowels employed in these exercises should be pronounced in the open Italian fashion, thus: A, *ah;* E, *e* in "pen" or *ai* in "pain"; I, *ee;* O, *oh;* U, *oo.* I recommend the constant use of Italian words as best calculated to cultivate the voice, and as being the most melodious.

All the exercises must be sung *legato*, taking a moderately quick time from the beginning, and paying particular attention to clearness of tone and purity of intonation; only after some months may the time be taken more quickly. The notes must be so joined to one another that they represent, so to speak, an unbroken line. (See also my Daily Vocal Exercises for Mezzo-Soprano, Soprano, and Tenor, p. 5, Nos. 1, 2, 3, 4.)

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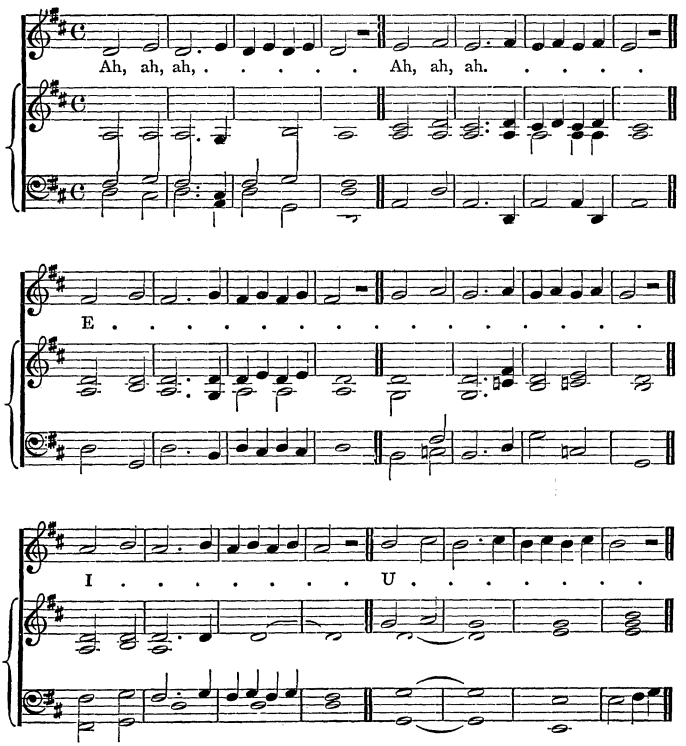
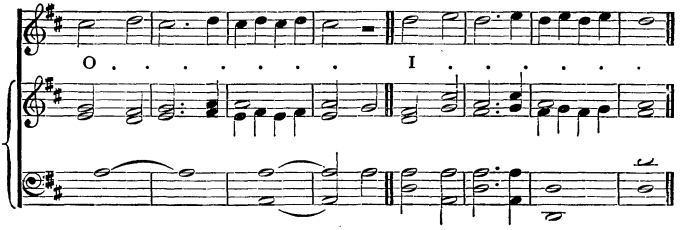
VOCAL EXERCISES.

I.

EXERCISES FOR THE ACQUISITION OF FLEXIBILITY.





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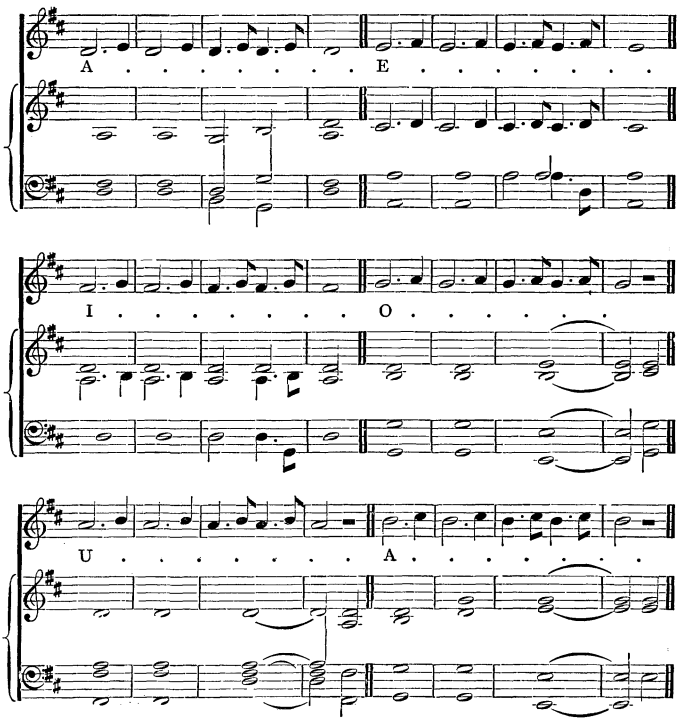
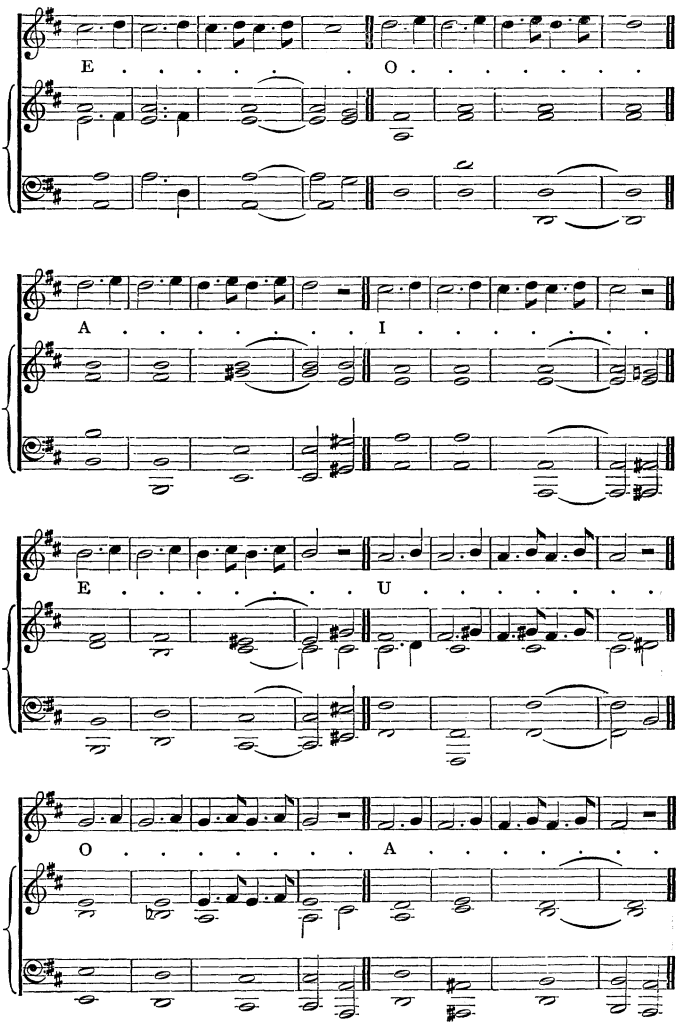
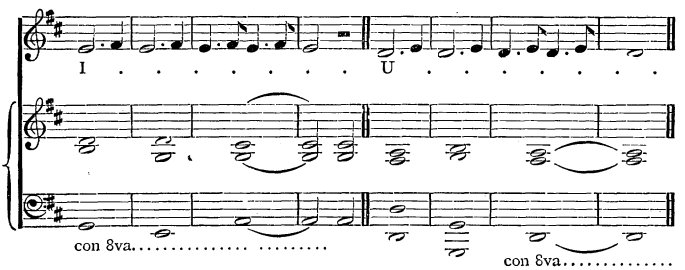



E . . . . . O . . . . . .
A . . . . . I . . . . . .
E . . . . . U . . . . . .
O . . . . . A . . . . . .



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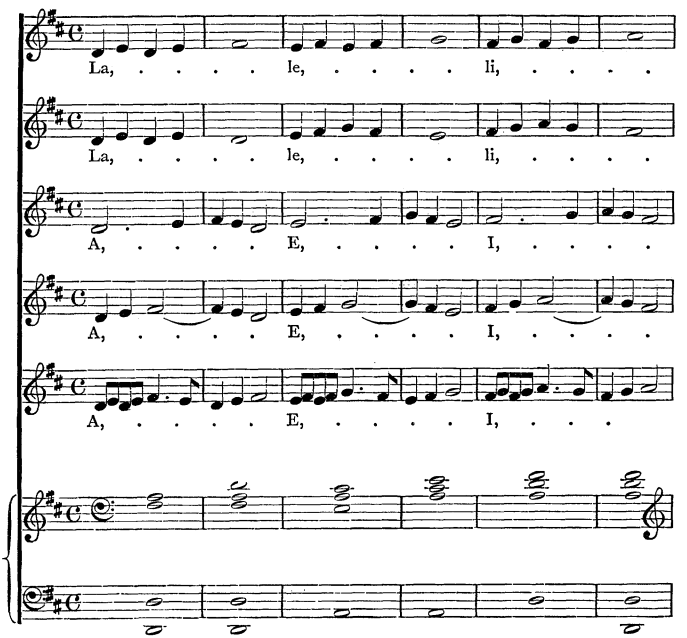
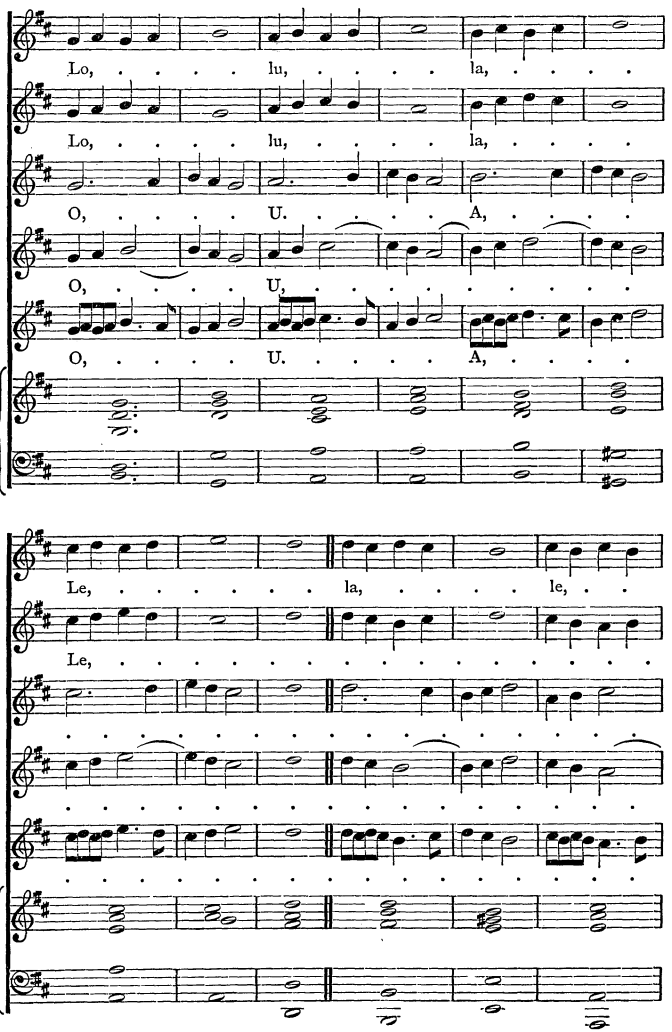
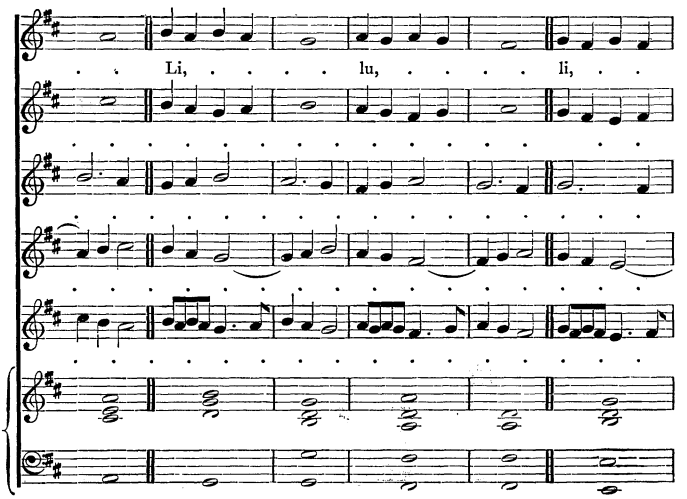
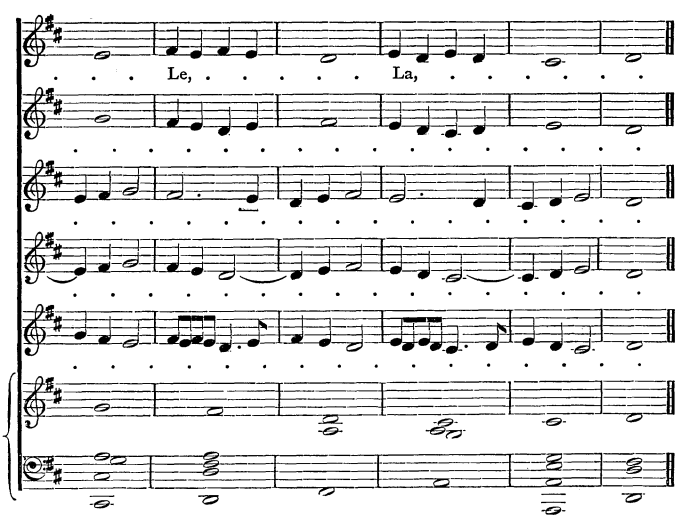
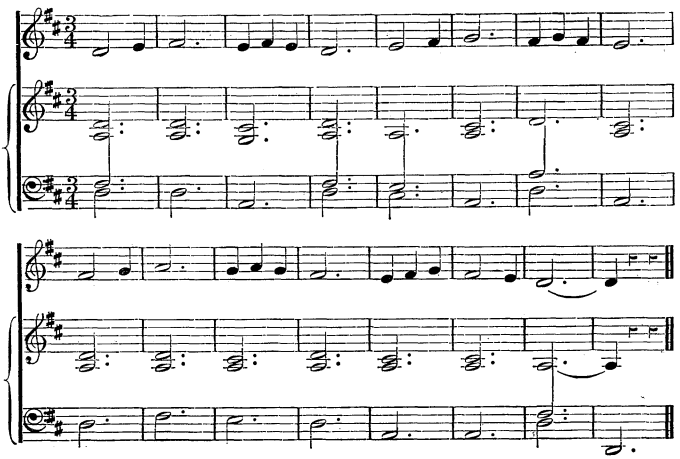



Lo, ... lu, ... la, ...
Lo, ... lu, ... la, ...
O, ... U. . . . . A, ...
O, ... U, ...
O, ... U. . . . . A, ...
Le, ... la, ... le, . .
Le, ...


Li, lu, li,


Le, La,

IV.



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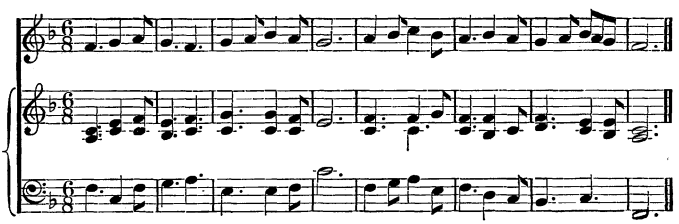

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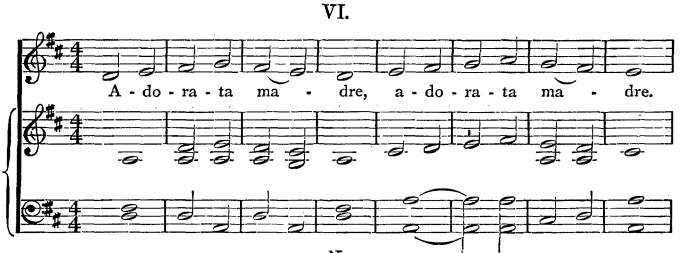

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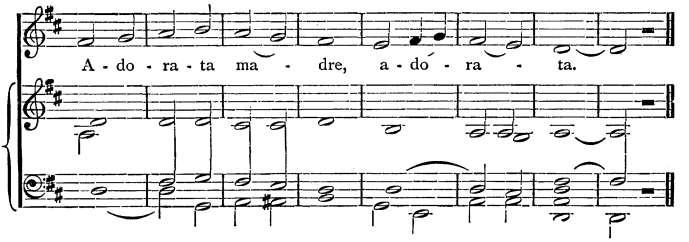

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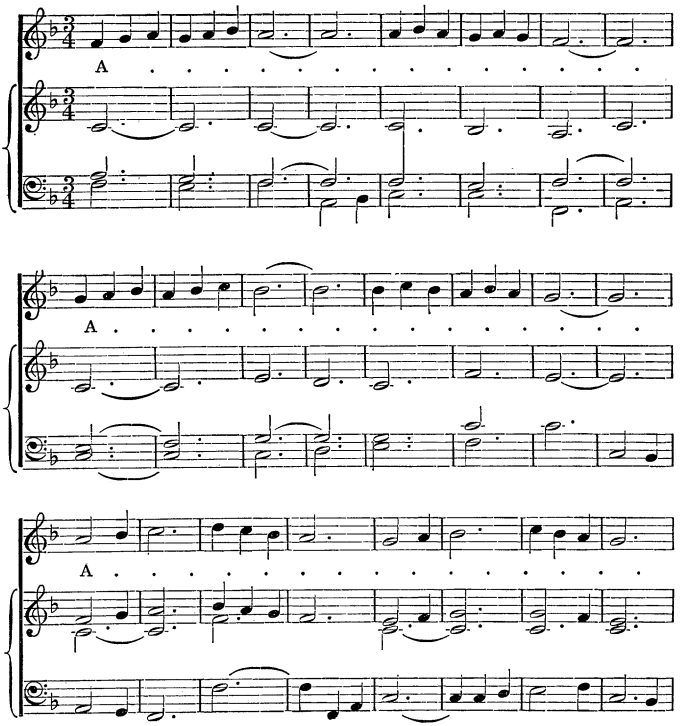

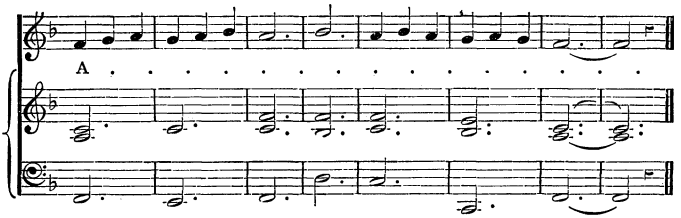

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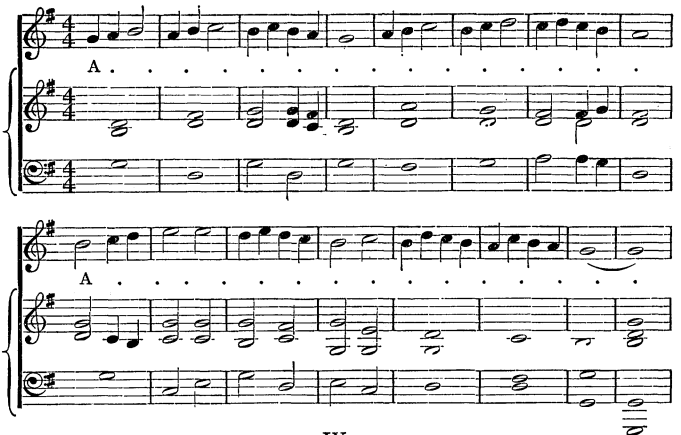

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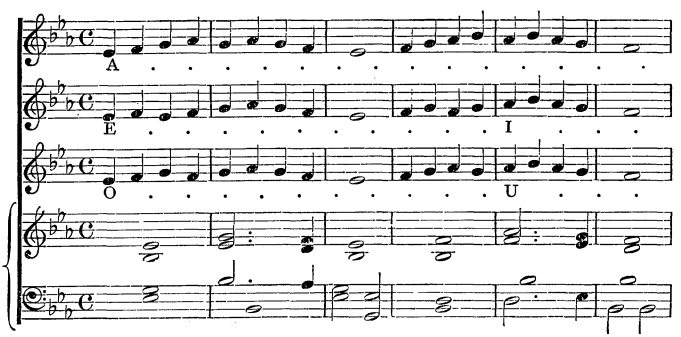

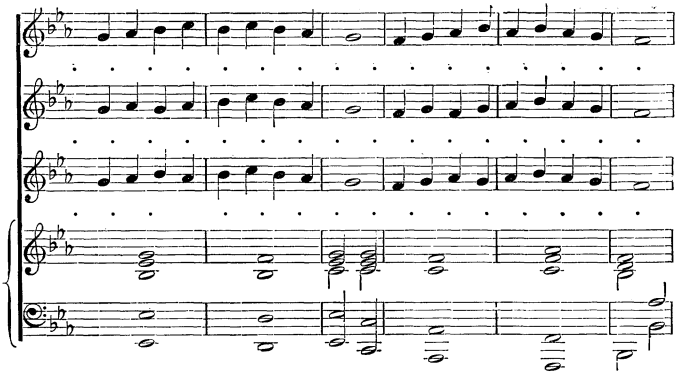

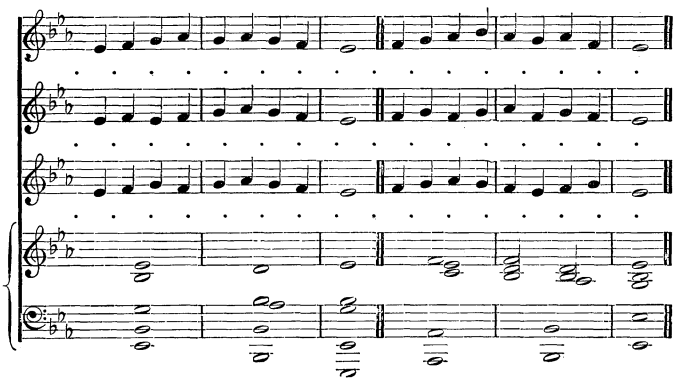

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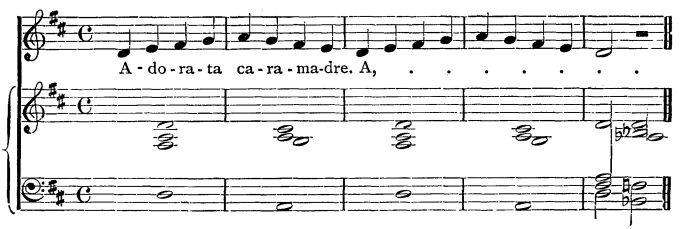
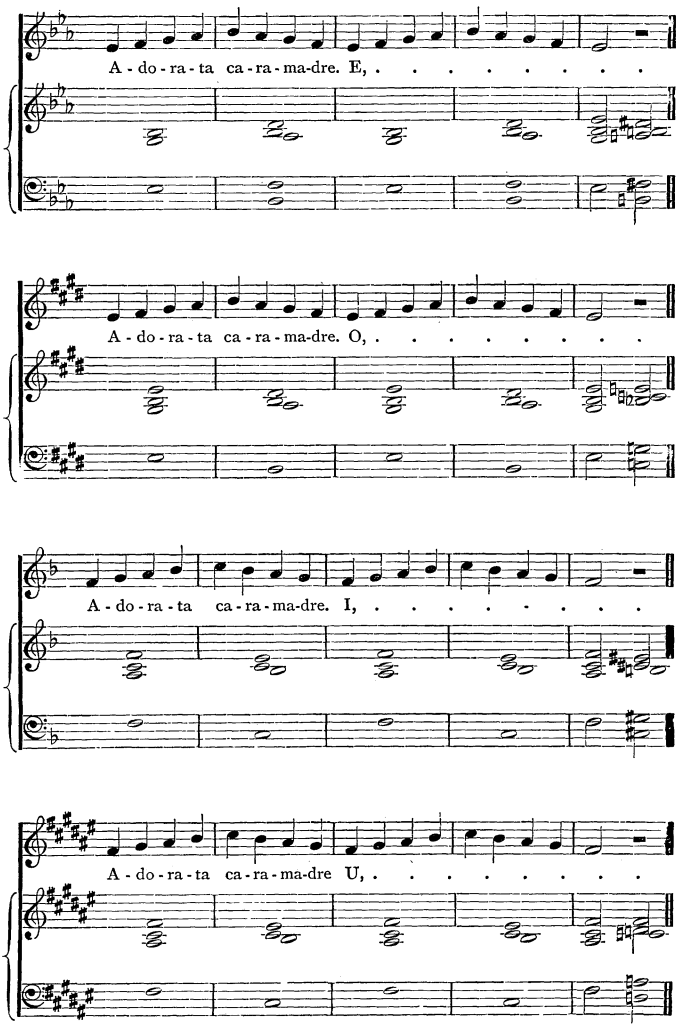
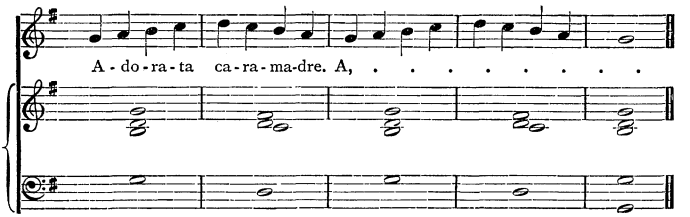
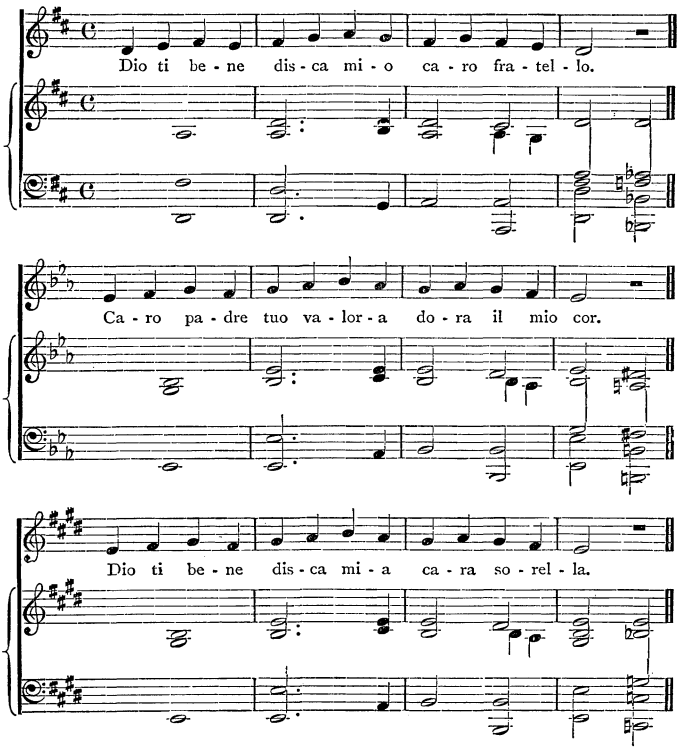
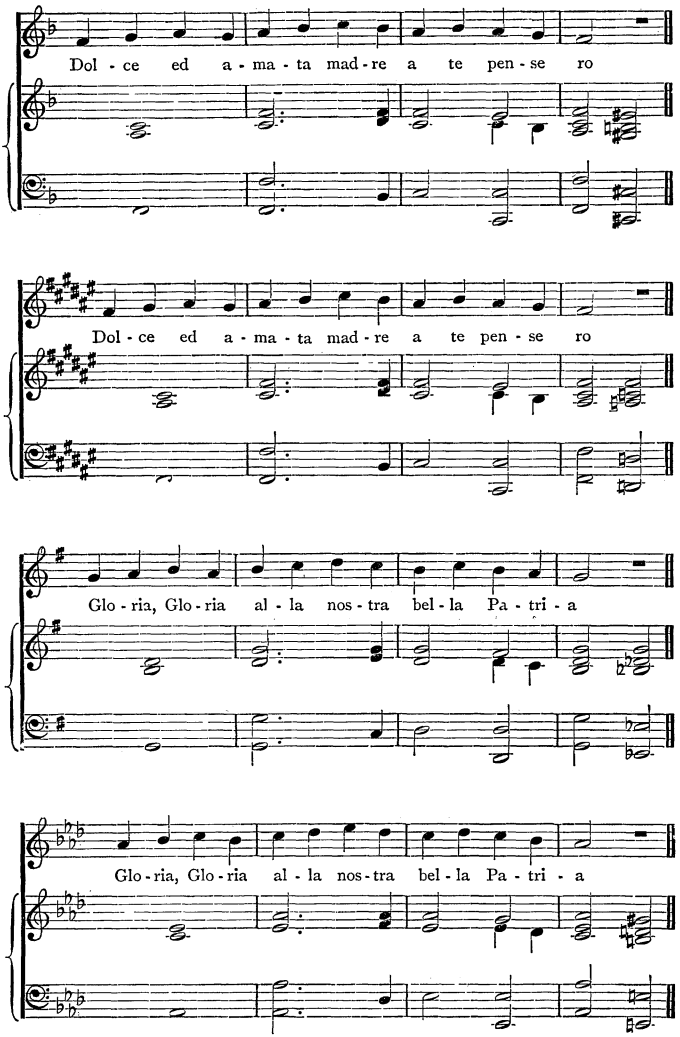


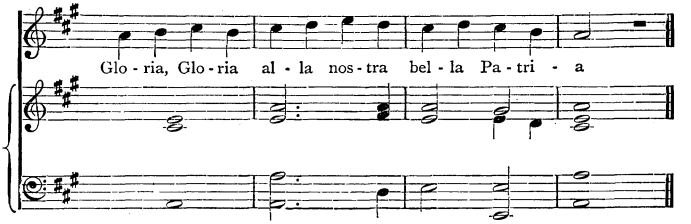

A - do - ra - ta ca - ra - ma-dre. E, ...
A - do - ra - ta ca - ra - ma-dre. O, ...
A - do - ra - ta ca - ra - ma-dre. I, ...
A - do - ra - ta ca - ra - ma-dre U, ...


A - do - ra - ta ca - ra - ma - dre. A, ...

XI.


Dio ti be - ne dis - ca mi - o ca - ro fra - tel - lo.
Ca - ro pa - dre tuo va - lor - a do - ra il mio cor.
Dio ti be - ne dis - ca mi - a ca - ra so - rel - la.


Dol - ce ed a - ma - ta mad - re a te pen - se ro
Dol - ce ed a - ma - ta mad - re a te pen - se ro
Glo - ria, Glo - ria al - la nos - tra bel - la Pa - tri - a
Glo - ria, Glo - ria al - la nos - tra bel - la Pa - tri - a



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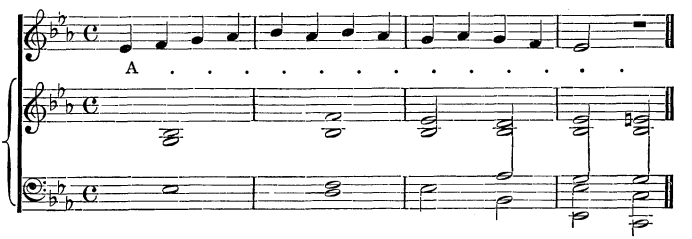

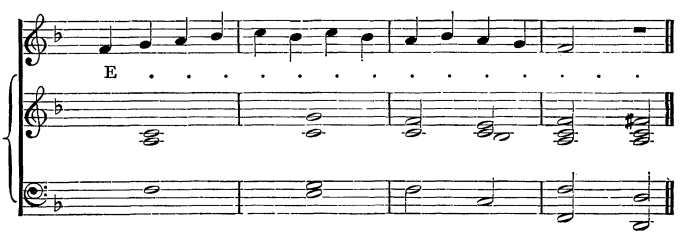

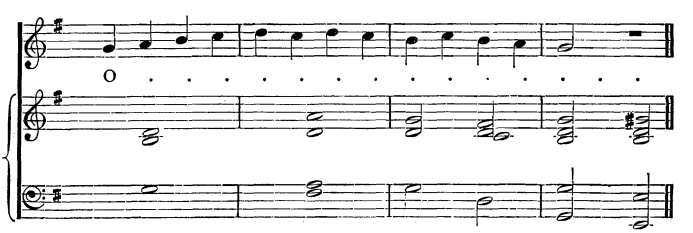

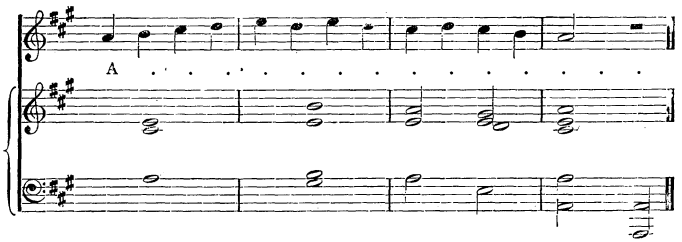

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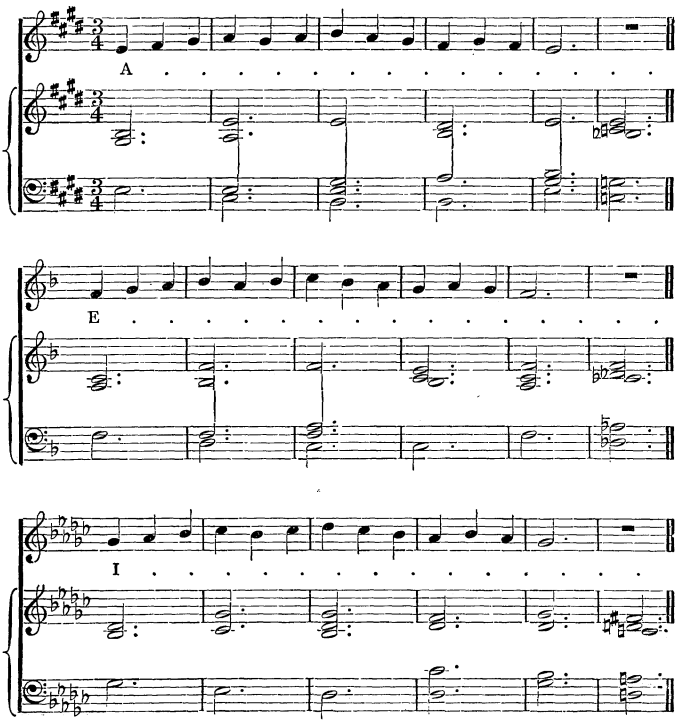

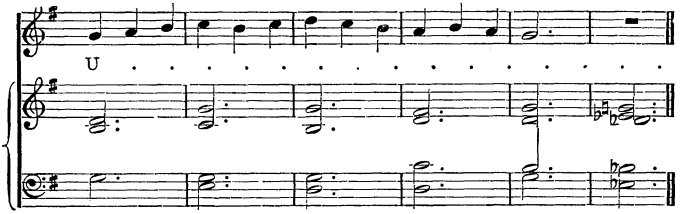

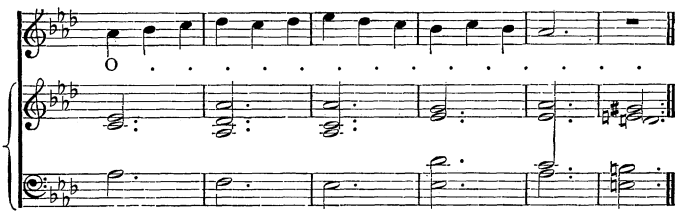

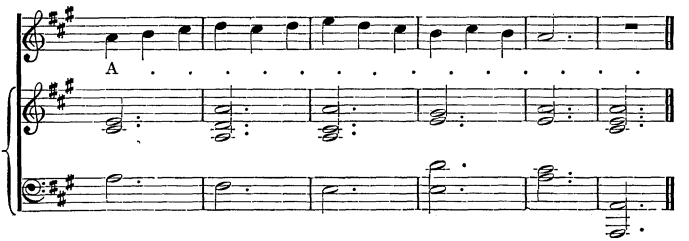

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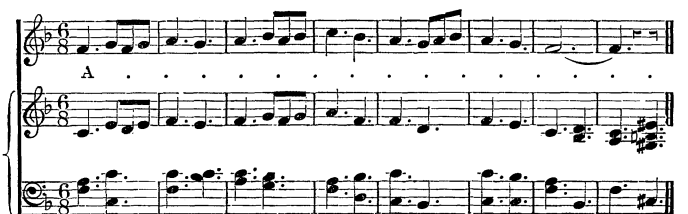
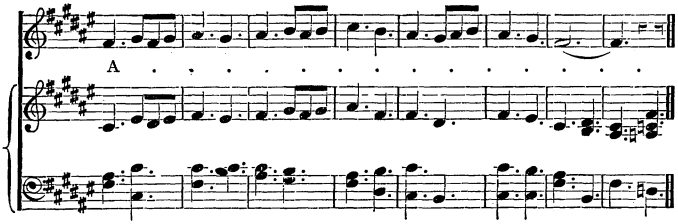
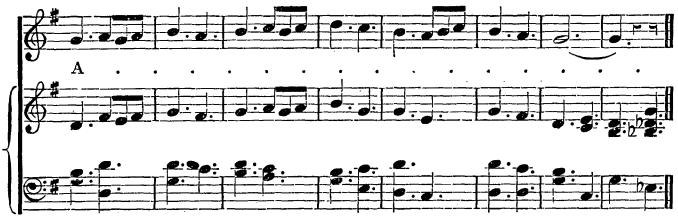
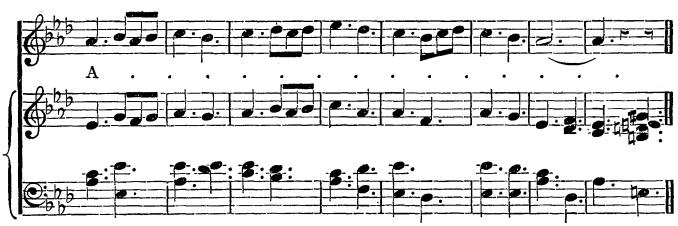
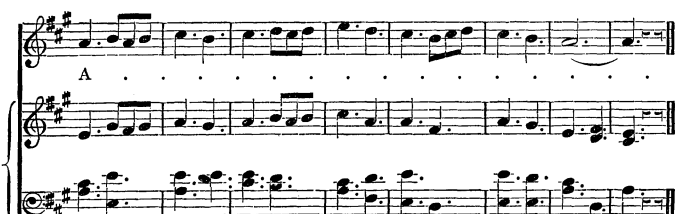


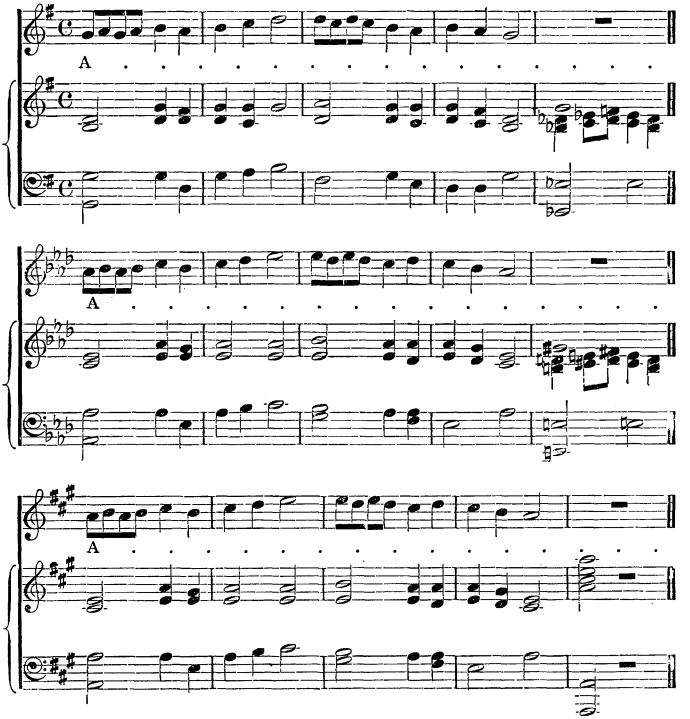

A


A


A


A

XV.



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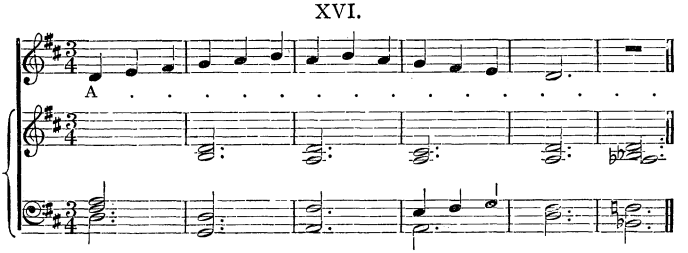
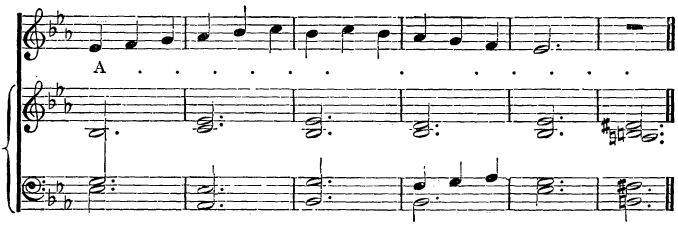
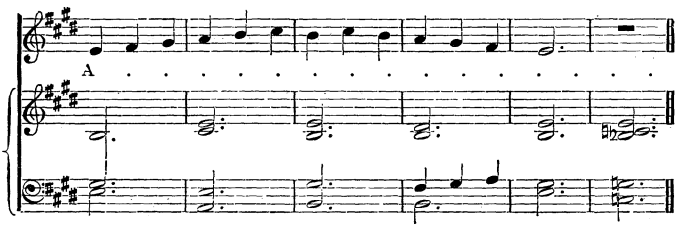
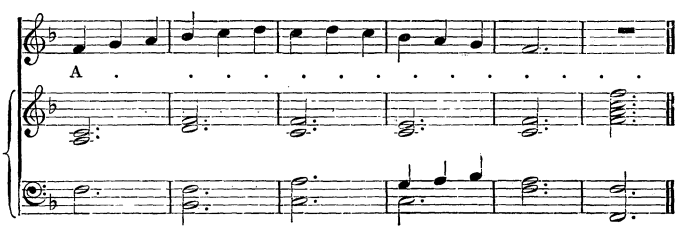
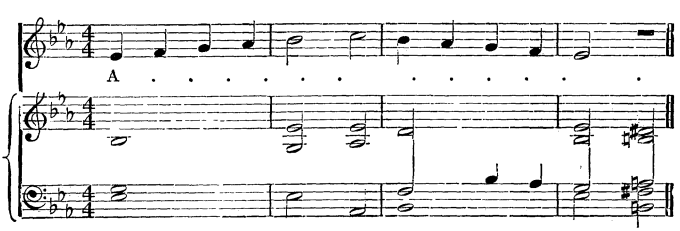


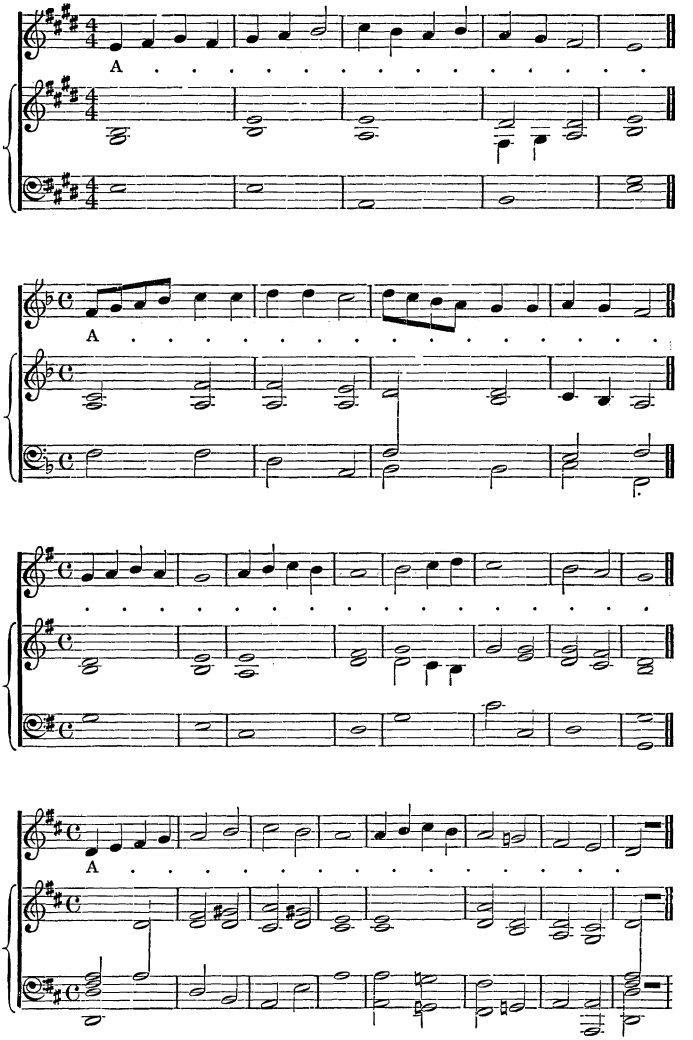


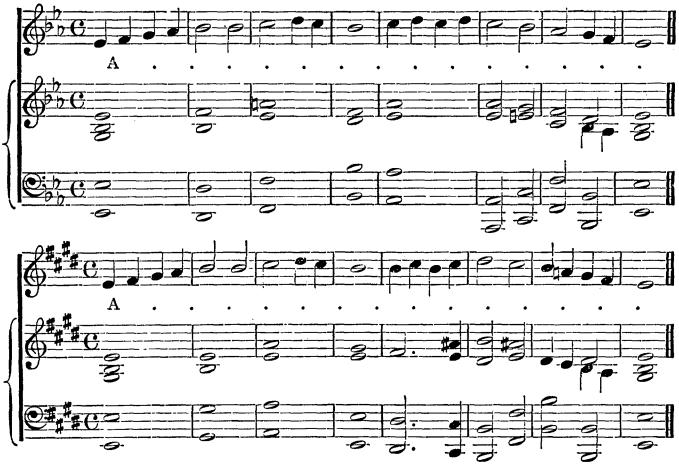




XVII.

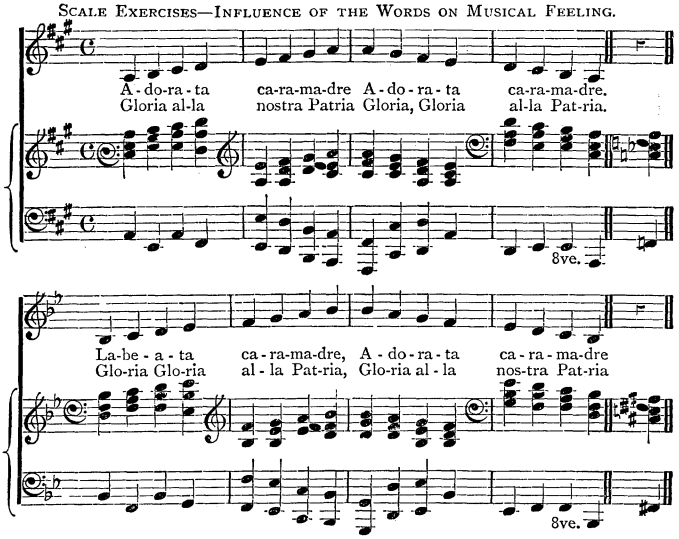


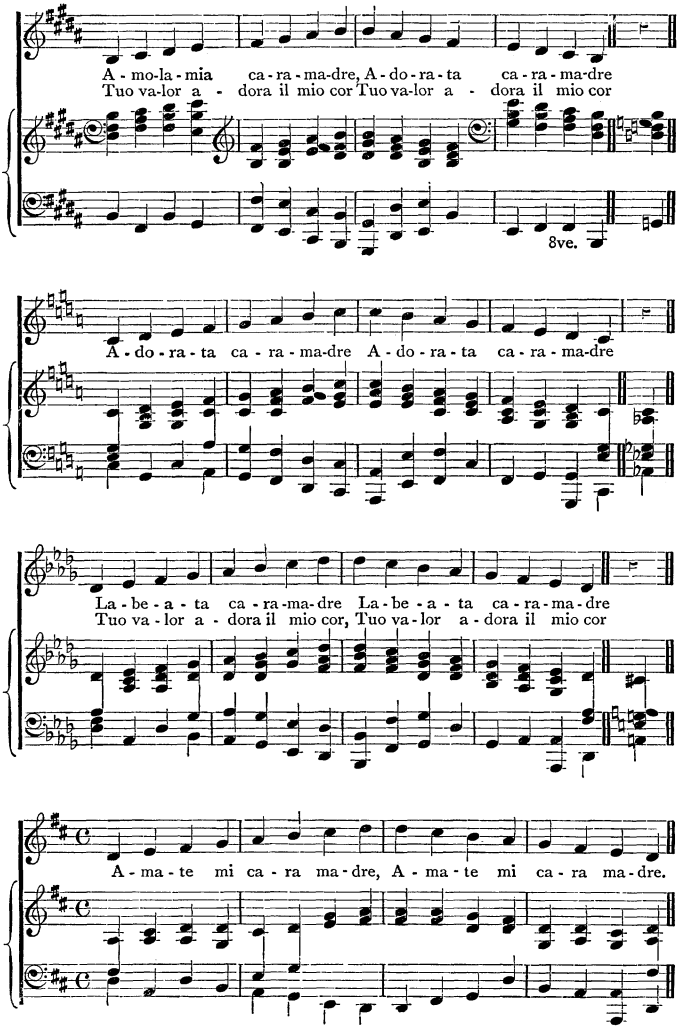

A
A
A
A

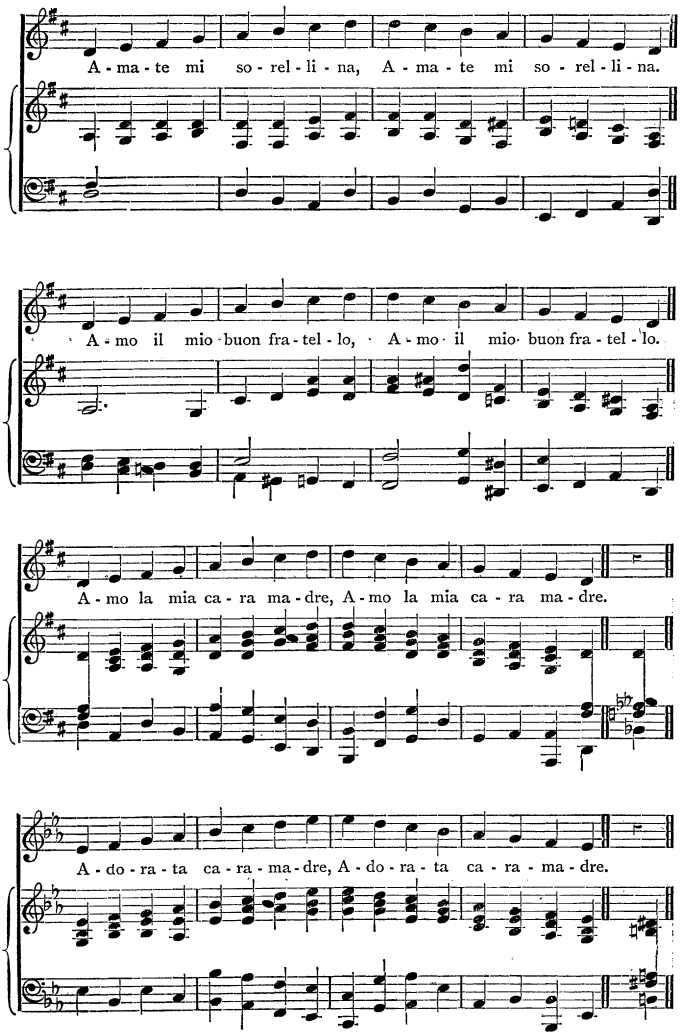


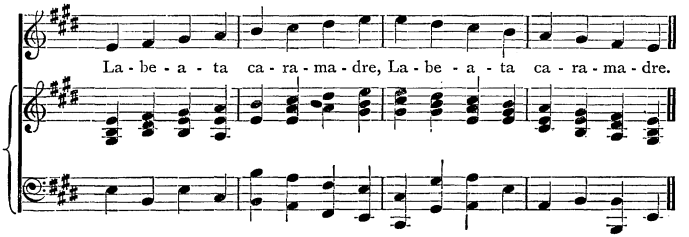
XVIII.

SCALE EXERCISES—INFLUENCE OF THE WORDS ON MUSICAL FEELING.

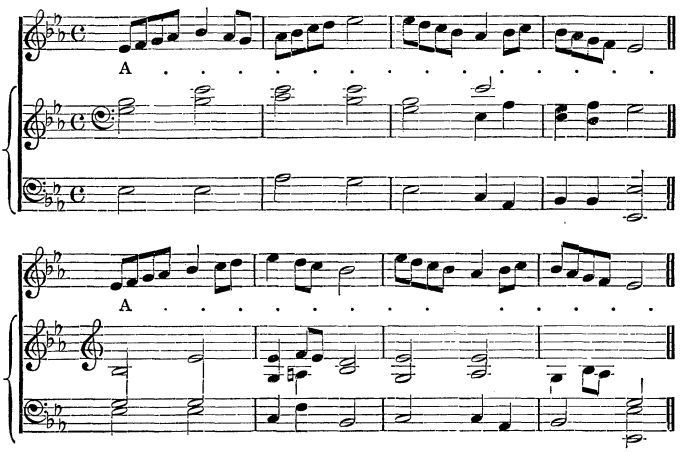



A - mo-la - mia ca - ra - ma-dre, A - do - ra - ta ca - ra - ma-dre
Tuo va-lor a - dora il mio cor Tuo va-lor a - dora il mio cor
8ve.
A - do - ra - ta ca - ra - ma-dre A - do - ra - ta ca - ra - ma-dre
La - be - a - ta ca - ra-ma-dre La - be - a - ta ca - ra - ma - dre
Tuo va - lor a - dora il mio cor, Tuo va-lor a - dora il mio cor
A - ma - te mi ca - ra ma - dre, A - ma - te mi ca - ra ma - dre.


A - ma - te mi so - rel - li - na, A - ma - te mi so - rel - li - na.
A - mo il mio buon fra - tel - lo, A - mo il mio buon fra - tel - lo.
A - mo la mia ca - ra ma - dre, A - mo la mia ca - ra ma - dre.
A - do - ra - ta ca - ra - ma - dre, A - do - ra - ta ca - ra - ma - dre.

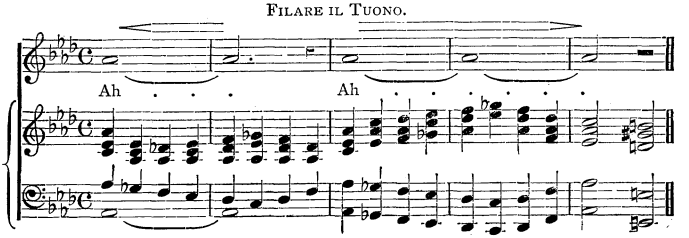


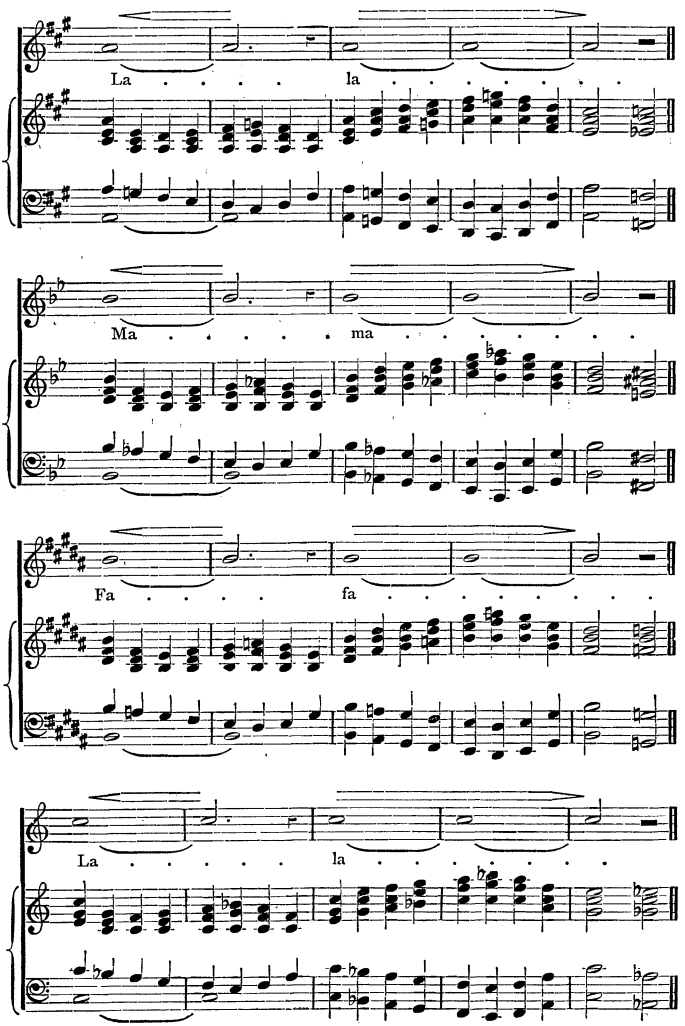
XIX.

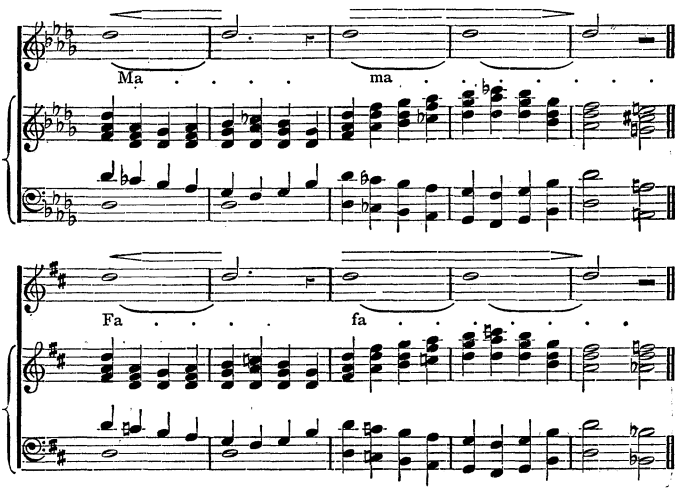


XX.

PREPARATORY EXERCISE FOR MESSA DI VOCE (Crescendo and Decrescendo), or FILARE IL TUONO.

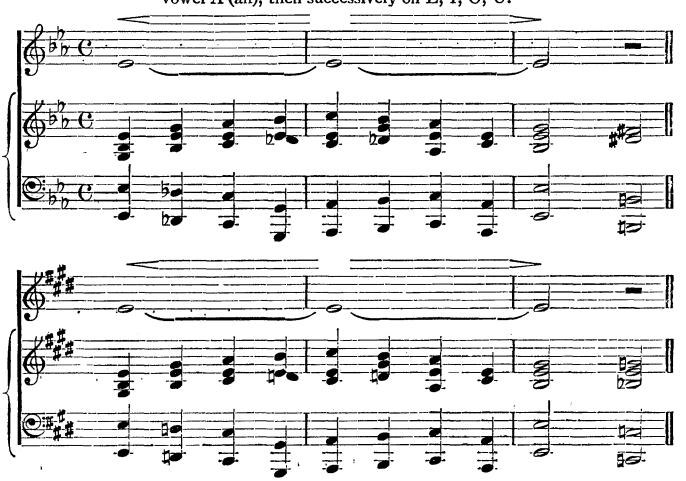


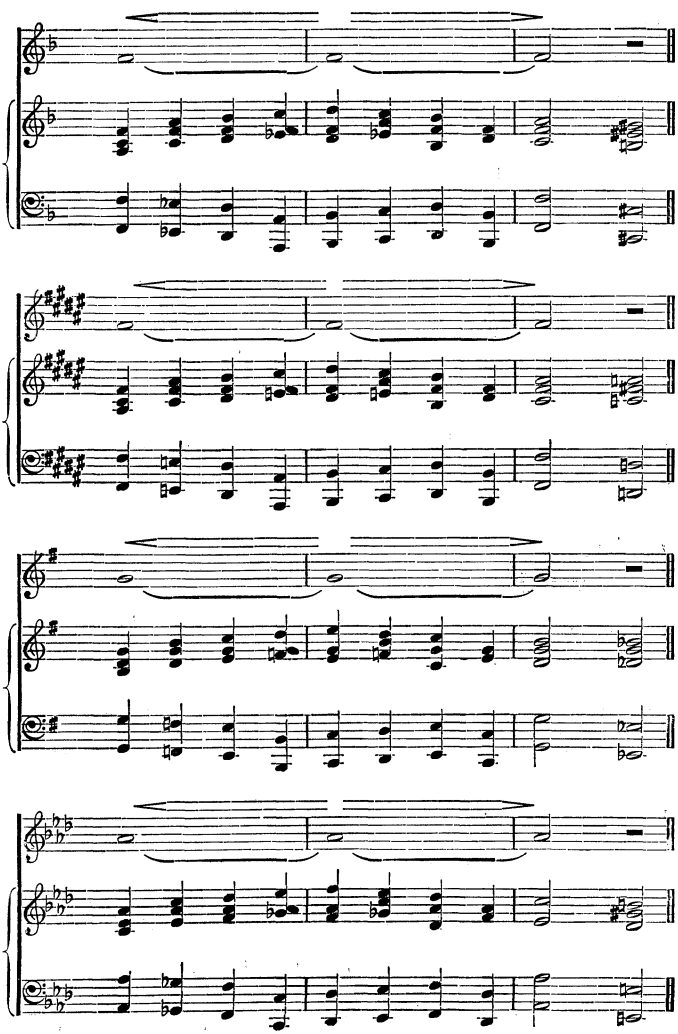

La . . . . la . . . . . .
Ma . . . . . ma . . . . . .
Fa . . . . fa . . . . . .
La . . . . la . . . . . .

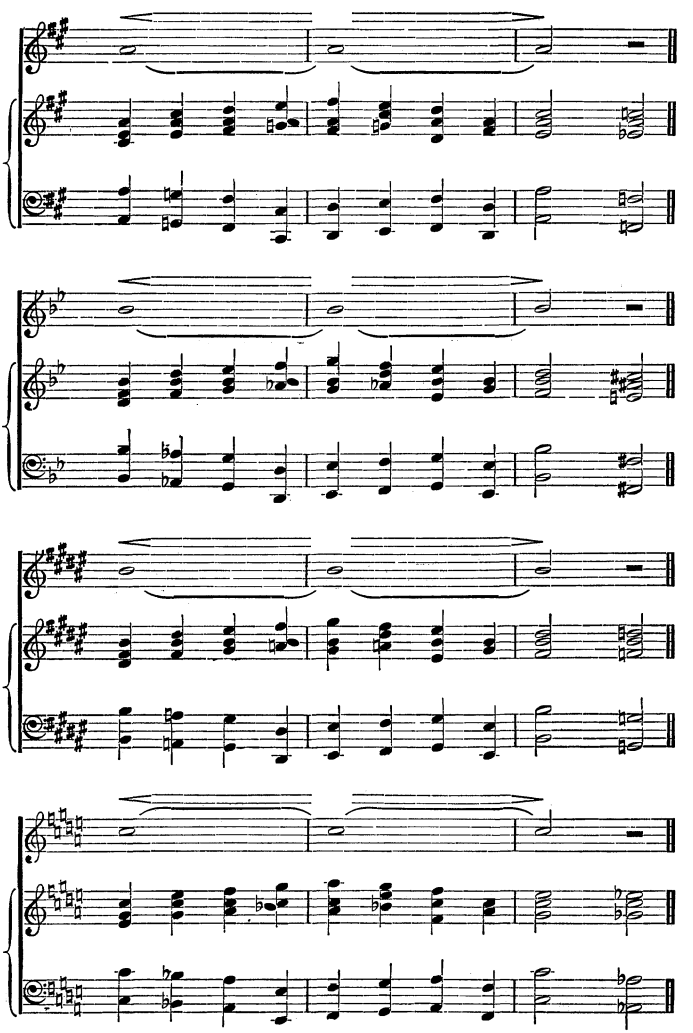


XXI.

MESSA DI VOCE, FILARE IL TUONO (Crescendo and Decrescendo), to be sung first on the vowel A (ah), then successively on E, I, O, U.







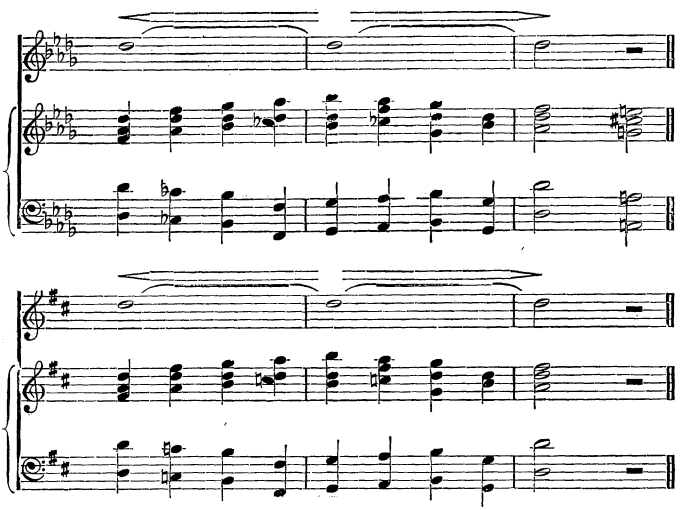
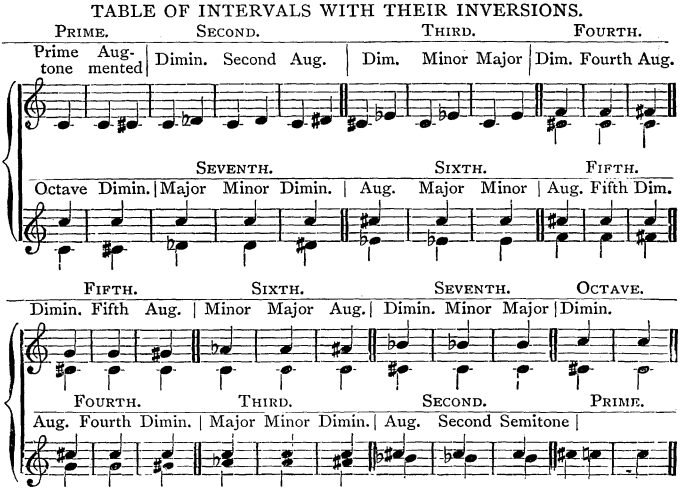
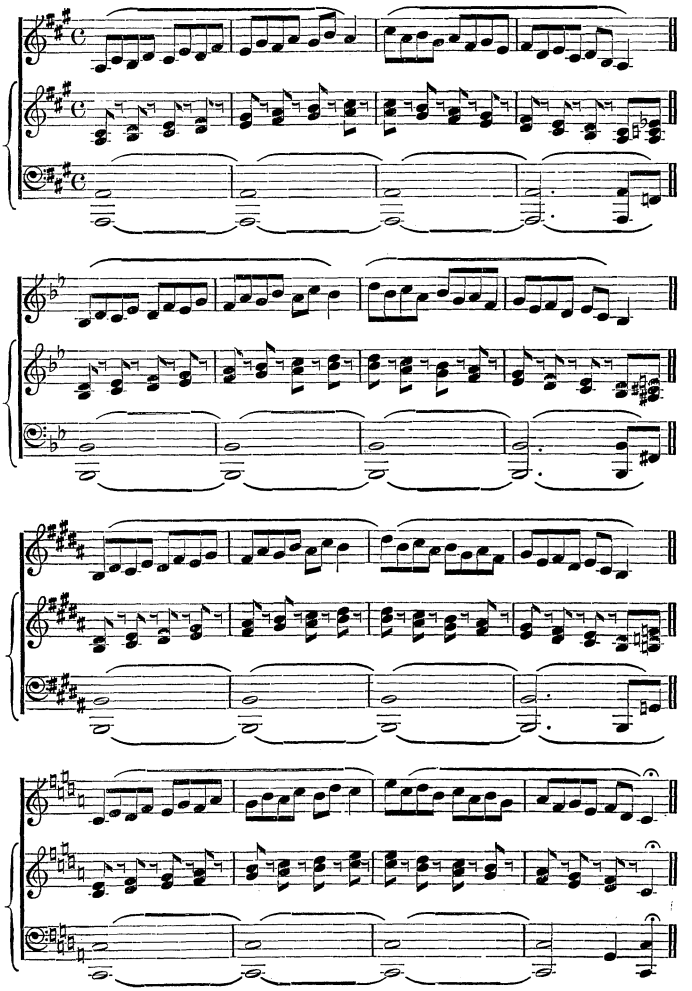


TABLE OF INTERVALS WITH THEIR INVERSIONS.

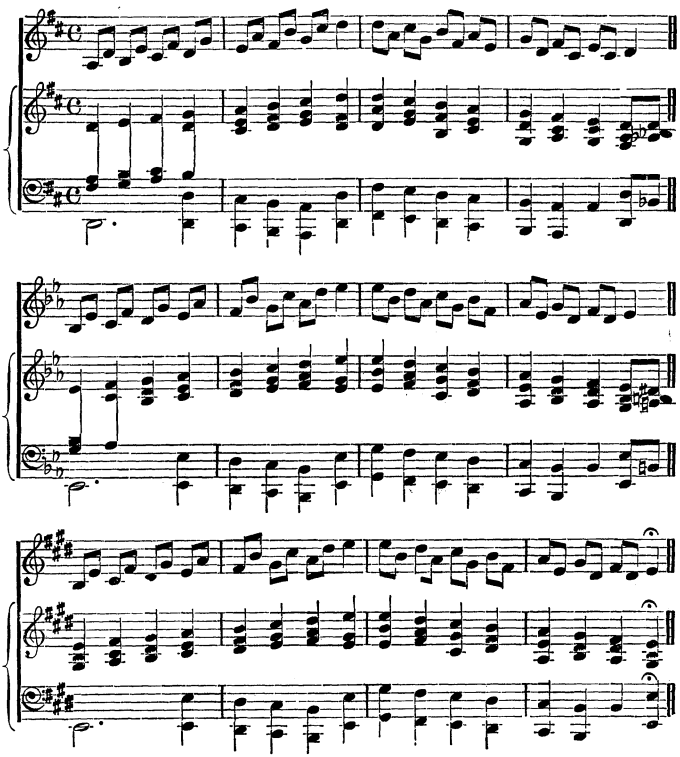


XXII.

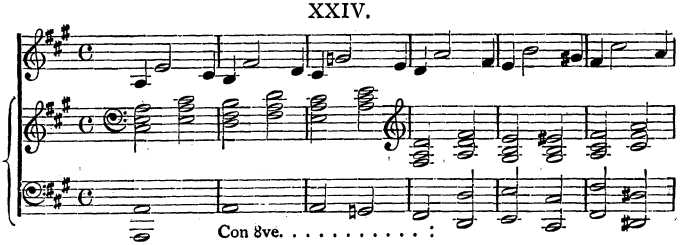
EXERCISES ON INTERVALS.

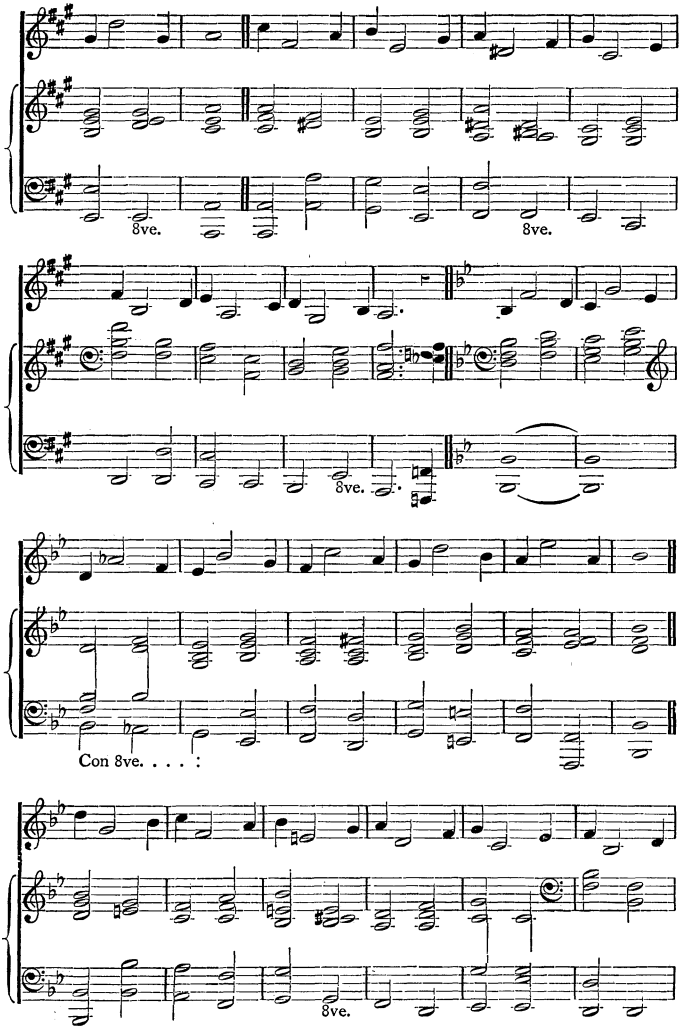


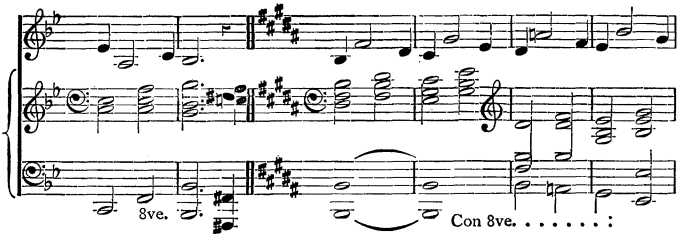
XXIII.

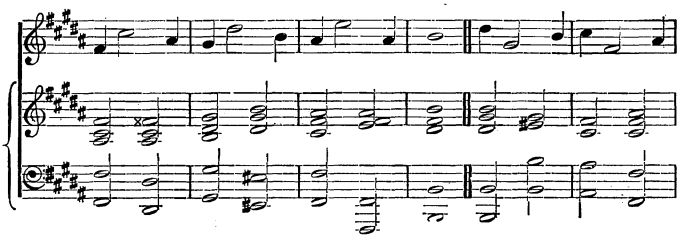


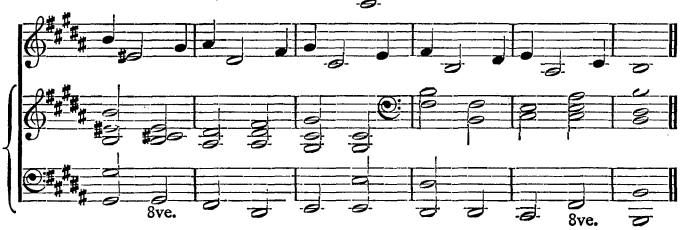
XXIV.



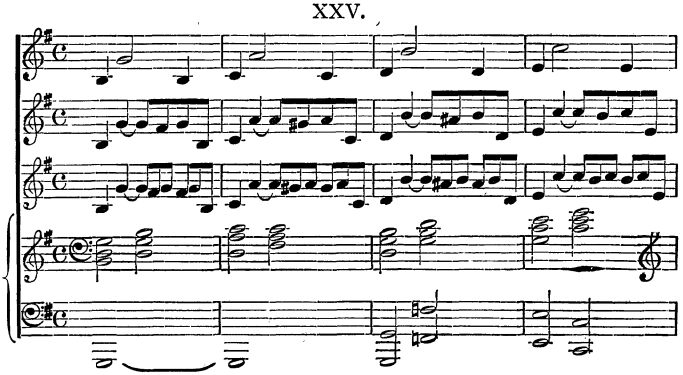

8ve.
8ve.
8ve.
Con 8ve. . . . :
8ve.

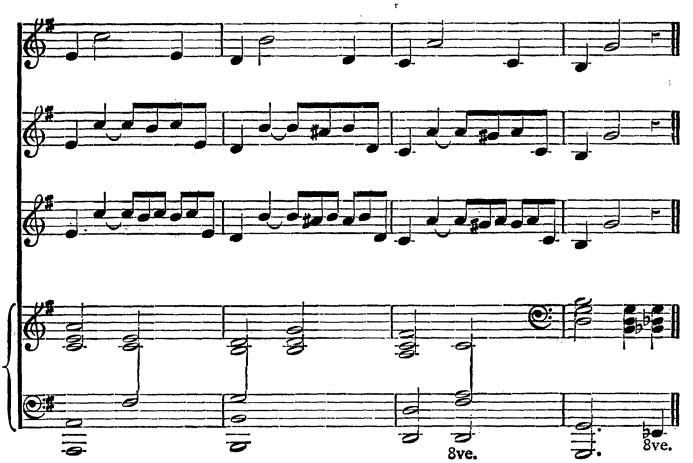


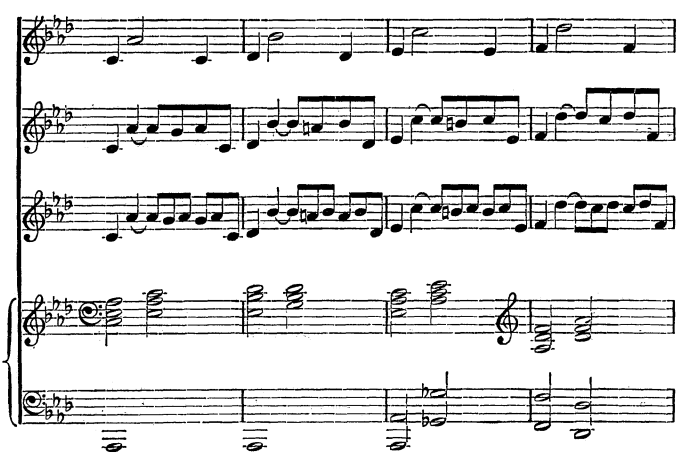


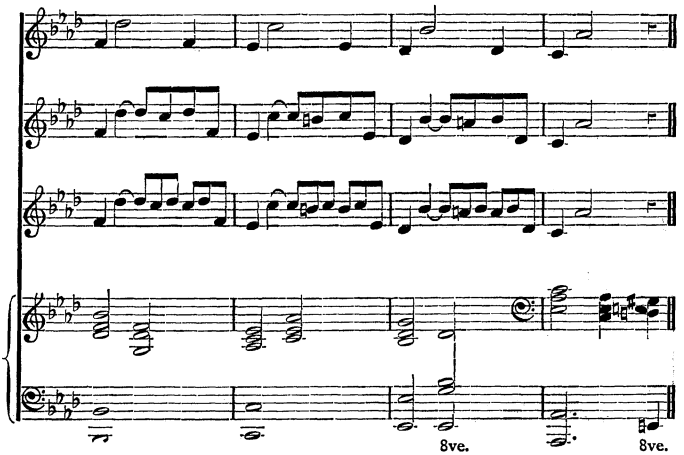


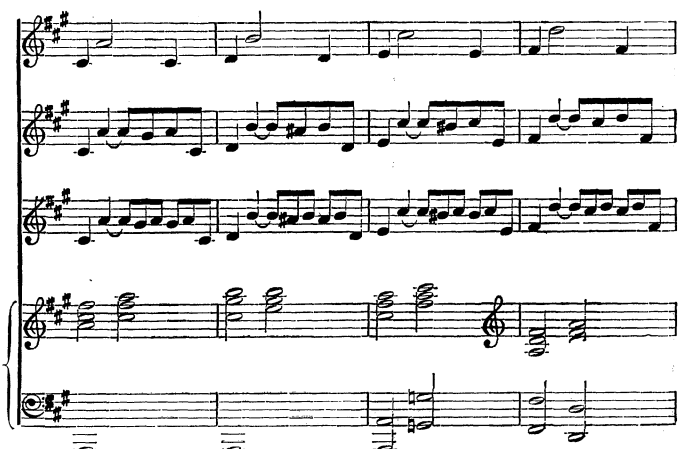
XXV.

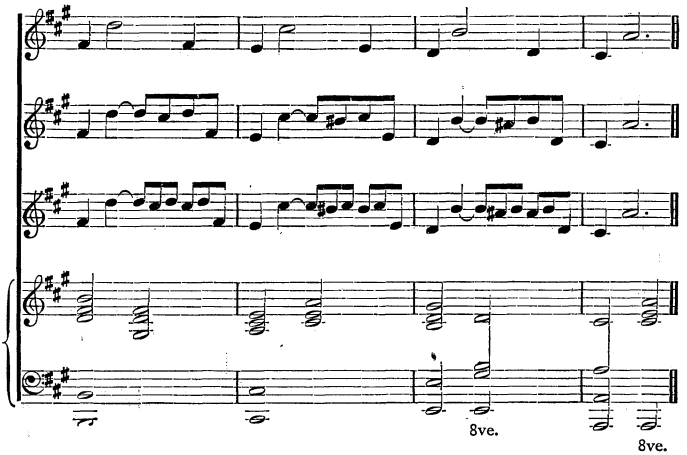



8ve.
8ve.

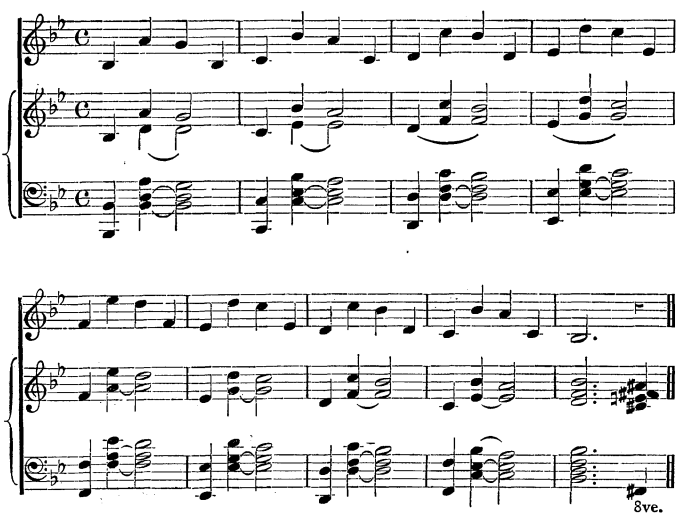


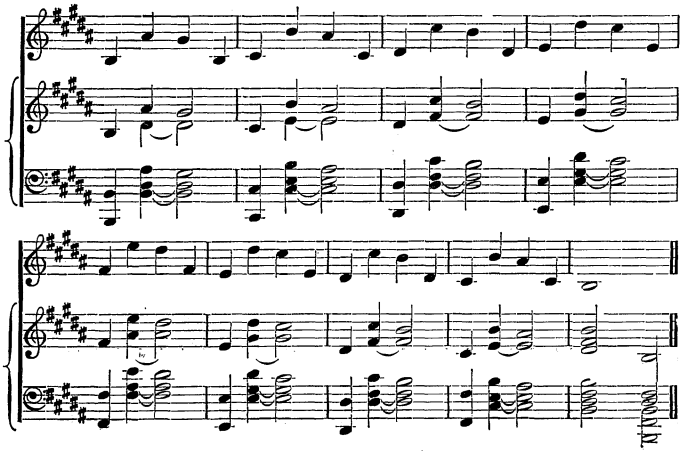

8ve.
8ve.





XXVI.

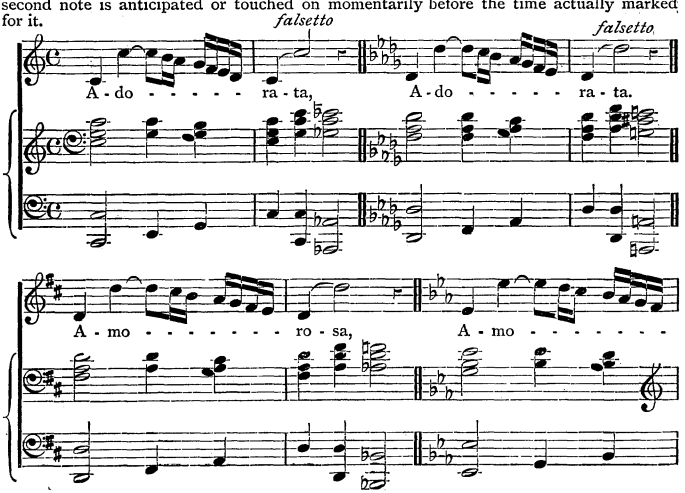


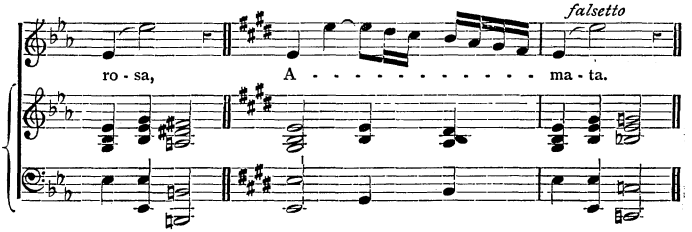


XXVII.

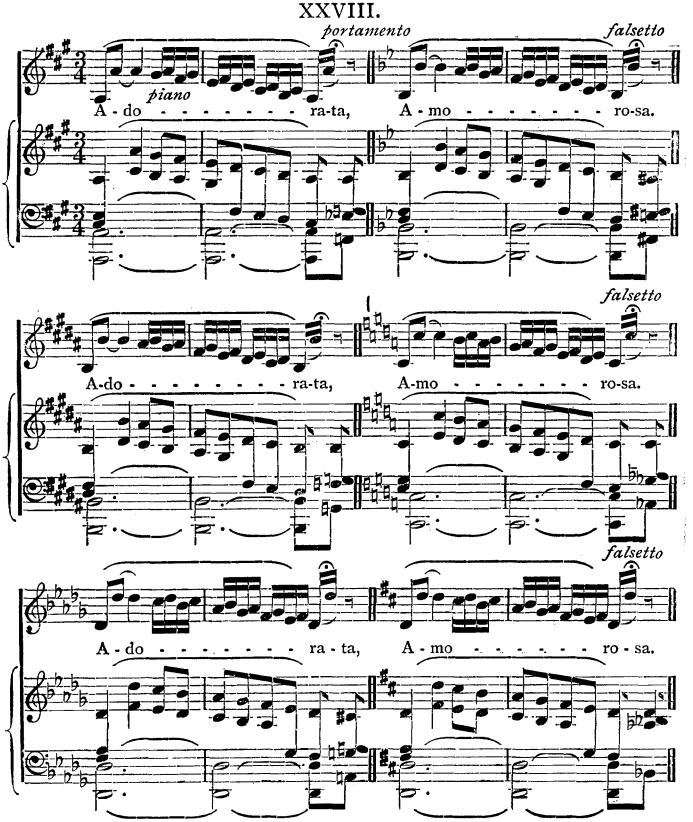
PORTAMENTO DI VOCE.

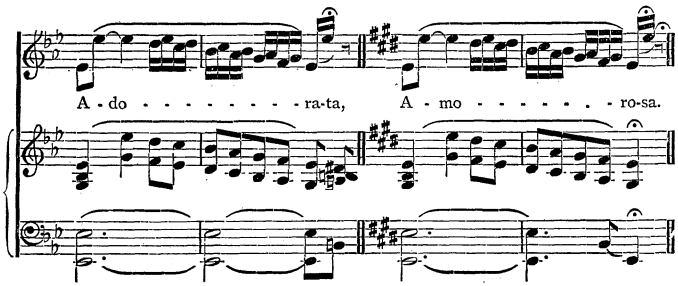
PORTAMENTO DI VOCE—This sustaining of the voice consists in the binding together of two notes that form a larger or smaller interval, by a gentle and easy slide, in which the second note is anticipated or touched on momentarily before the time actually marked for it.




falsetto
ro - sa, A - - - - - - - - - - - - ma - ta.

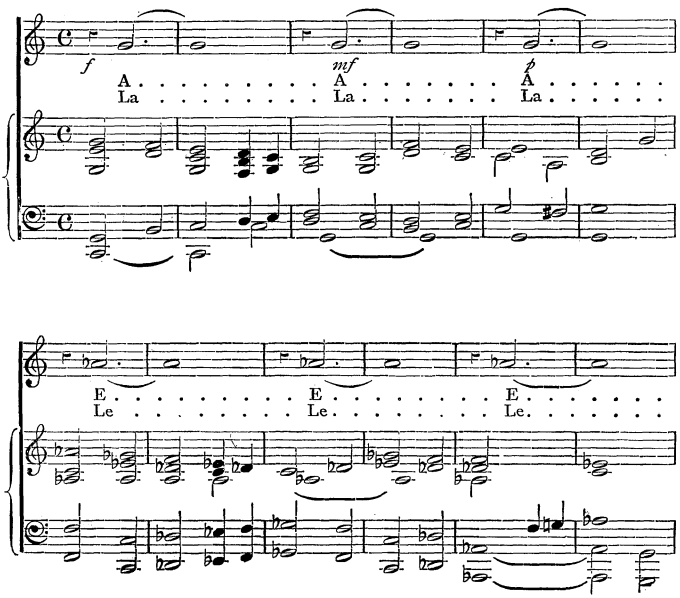
XXVIII.

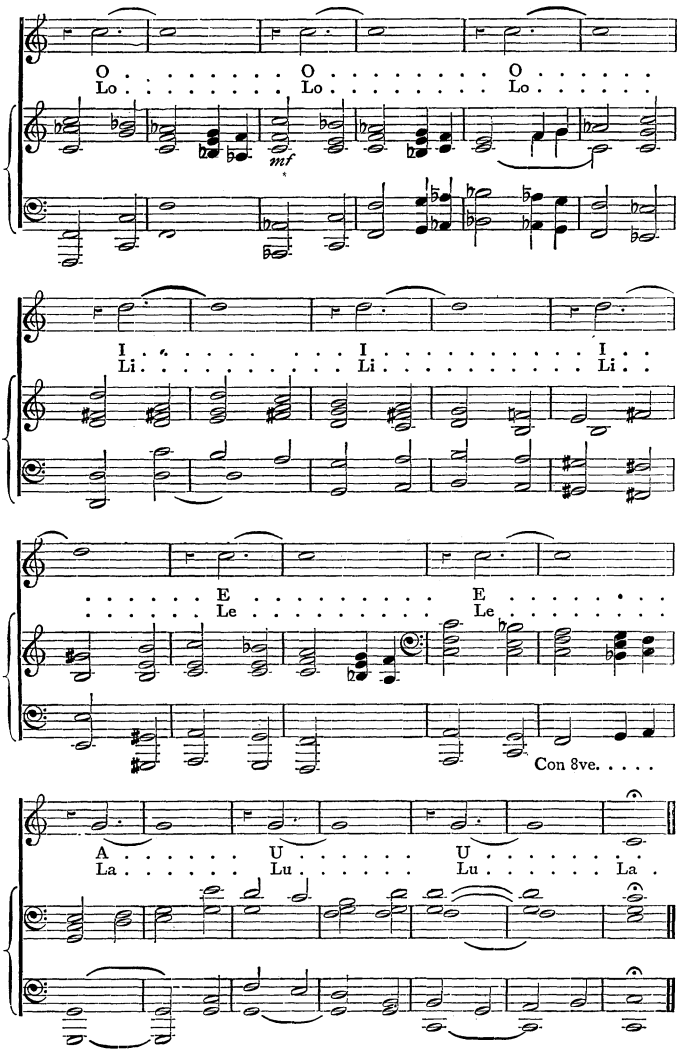

portamento
falsetto
piano
A - do - - - - - - - - ra-ta, A - mo - - - - - - - - ro-sa.
falsetto
A-do - - - - - - - - - ra-ta, A-mo - - - - - - - - ro-sa.
falsetto
A - do - - - - - - - - ra - ta, A - mo - - - - - - - - ro - sa.



XXIX.

EXERCISE ON THE THREE DIFFERENT MODES OF ATTACK.

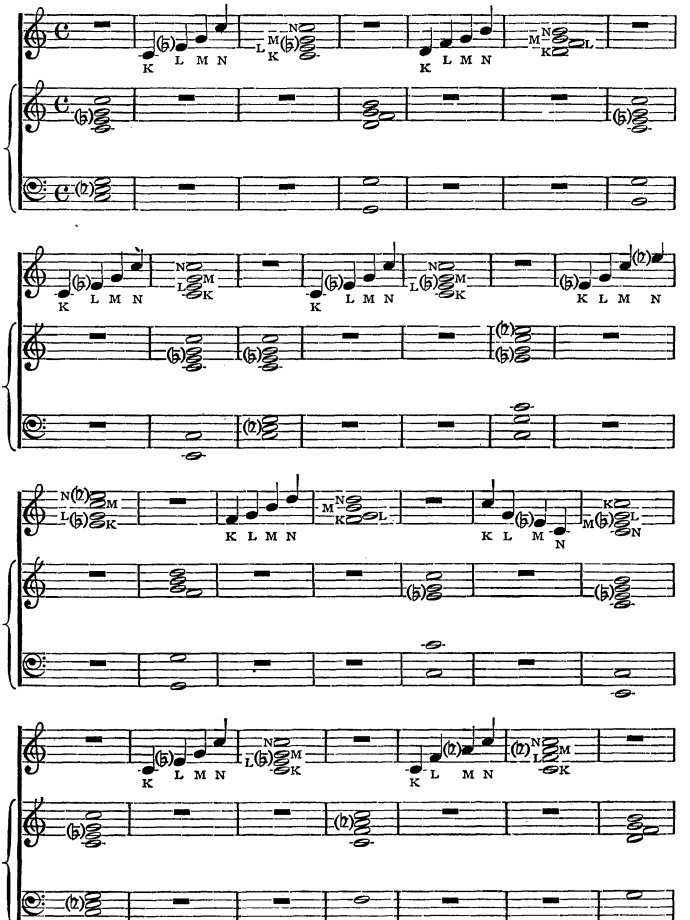


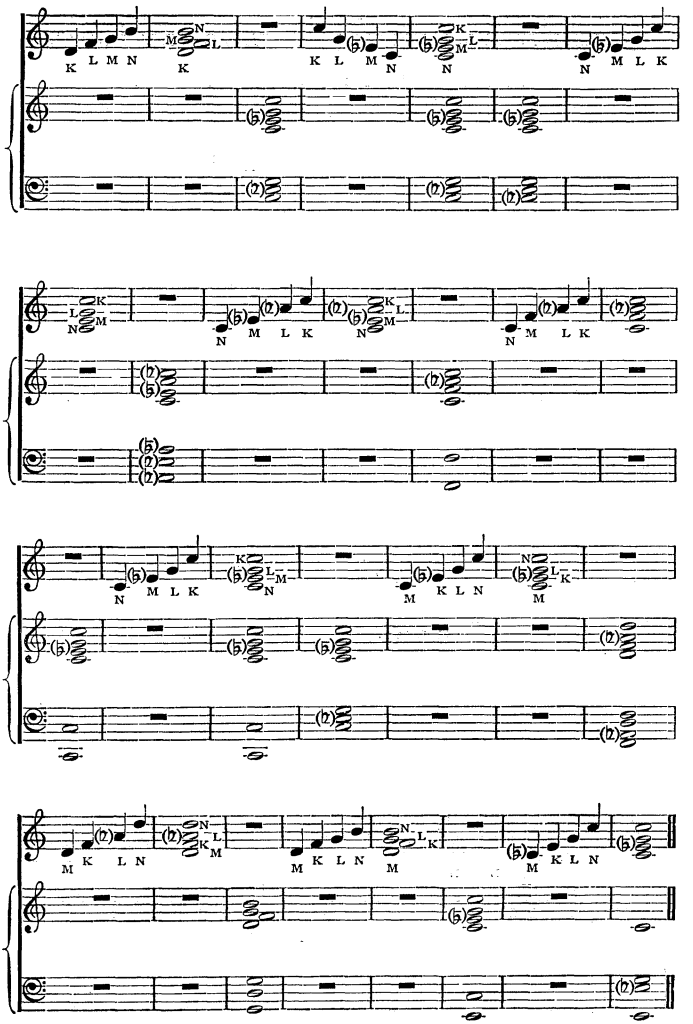

O Lo
O Lo
O Lo
mf
I Li
I Li
I Li
E Le
E Le
Con 8ve.
A La
U Lu
U Lu
La

XXX.

EXERCISE FOR FOUR VOICES, WITH FULL CHORDS IN MAJOR AND MINOR.

"K," Kate; "L," Lilly; "M," Mary; "N," Nina.

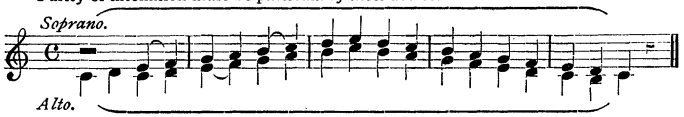



K L M N
K L M N
M L K
M K L N
M K L N
M K L N

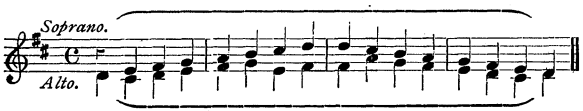
XXXI.

EXERCISES FOR TWO VOICES (*see p.* 115).

Purity of intonation must be particularly attended to.

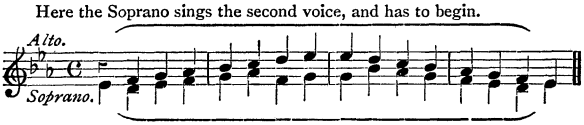


XXXII.

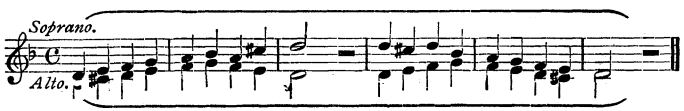


XXXIII.

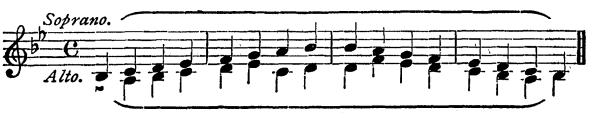
Here the Soprano sings the second voice, and has to begin.



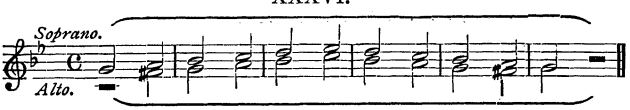
XXXIV.



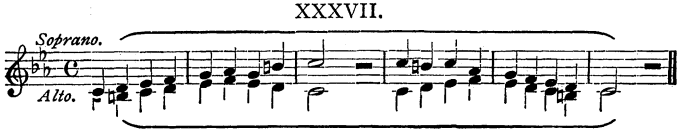
XXXV.



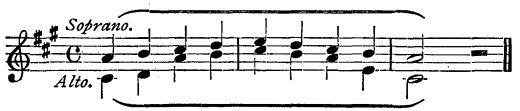
XXXVI.



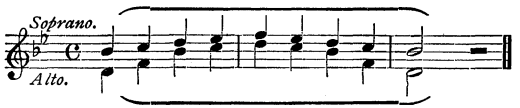
XXXVII.



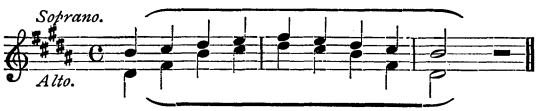
XXXVIII.



XXXIX.

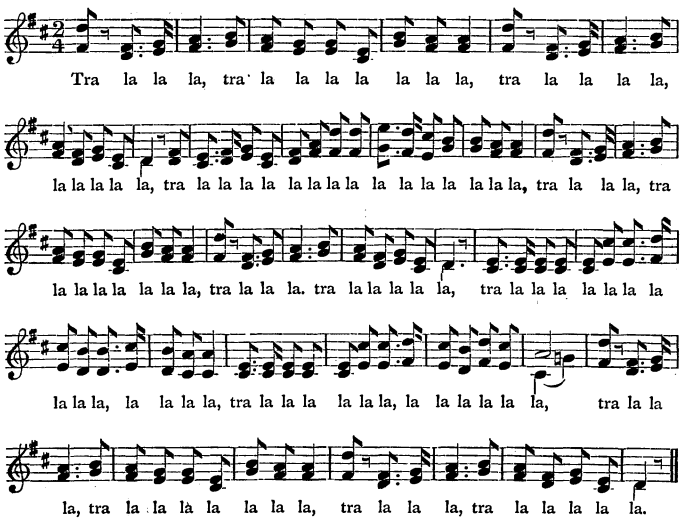


XL.



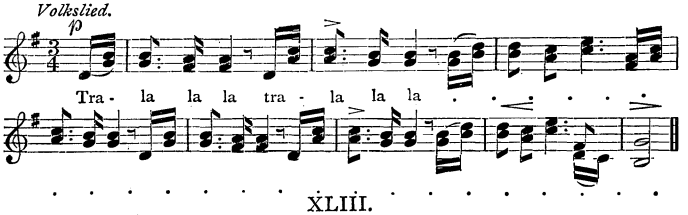
XLI.

SIMPLE SONGS FOR TWO VOICES.



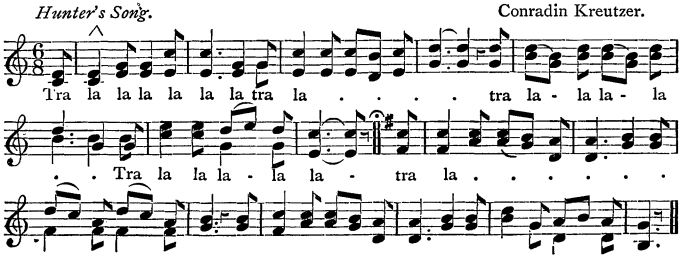
XLII.

Volkslied.



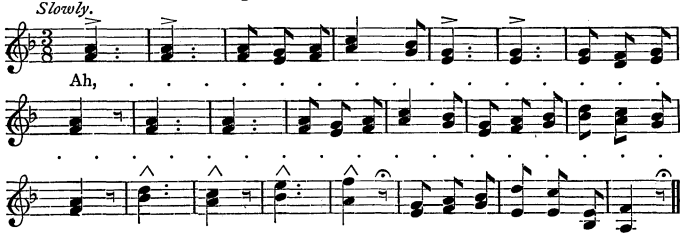
XLIII.

Hunter's Song. Conradin Kreutzer.



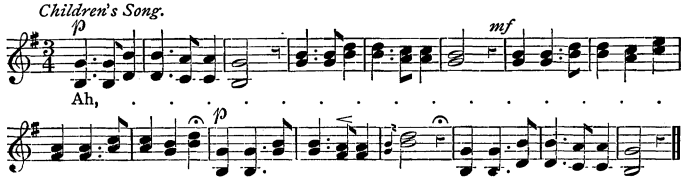
XLIV.

Old German National Song.
Slowly.



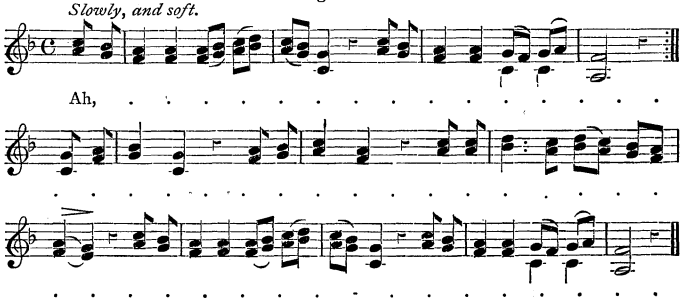
XLV.

Children's Song.



XLVI.

Volksweise: Austrian National Song.
Slowly, and soft.

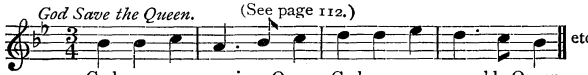


XLVII.

SONGS BEGINNING WITH DIFFERENT INTERVALS.

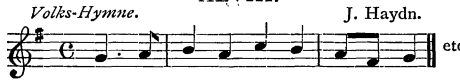
INTERVAL OF THE SECOND.

God Save the Queen. (See page 112.)



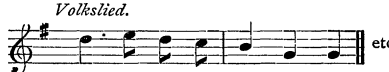
XLVIII.

Volks-Hymne. J. Haydn.



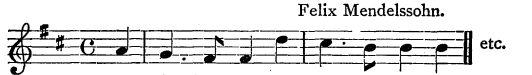
XLIX.

Volkslied.



L.

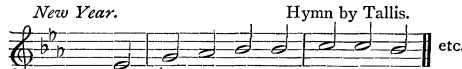
Felix Mendelssohn.



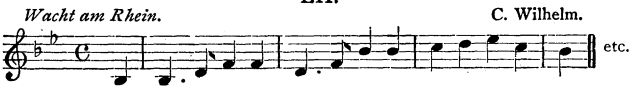
LI.

INTERVAL OF THE THIRD.

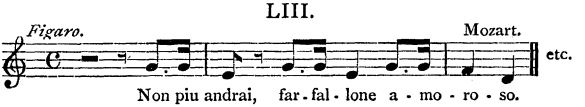
New Year. Hymn by Tallis.



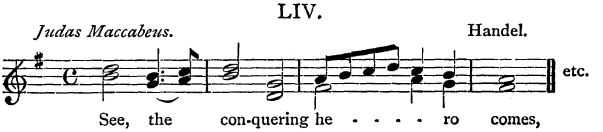
LII.



LIII.

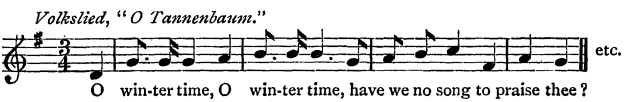


LIV.

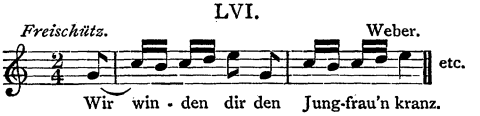


LV.

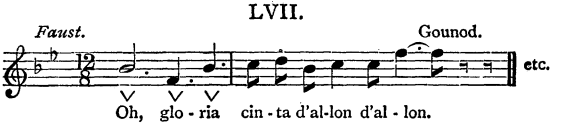
INTERVAL OF THE FOURTH.



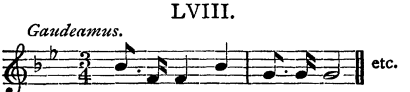
LVI.



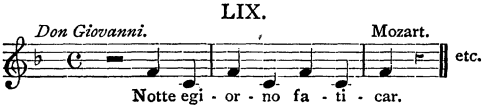
LVII.



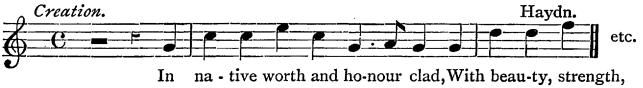
LVIII.



LIX.

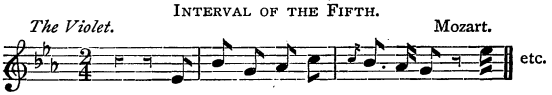


LX.

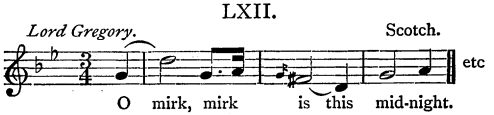


LXI.

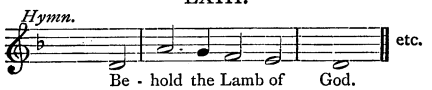
INTERVAL OF THE FIFTH.



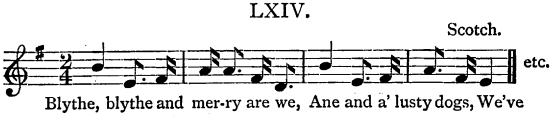
LXII.



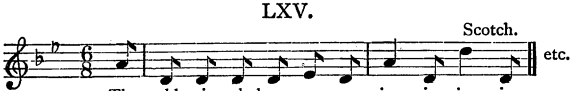
LXIII.



LXIV.

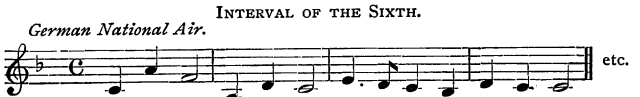


LXV.

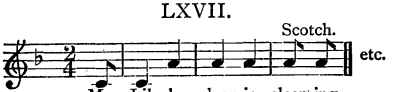


LXVI.

INTERVAL OF THE SIXTH.

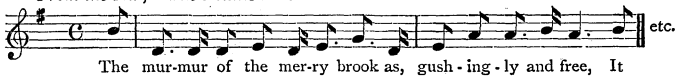


LXVII.



LXVIII.

From the Air, "*The Bonnie Brier Bush.*" Scotch.

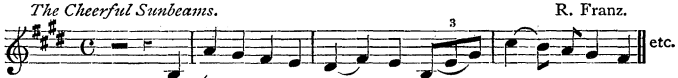


The mur-mur of the mer-ry brook as, gush - ing - ly and free, It

LXIX.

INTERVAL OF THE SEVENTH.

The Cheerful Sunbeams. R. Franz.

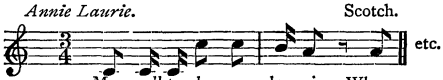


The cheer-ful sun-beams glist-en, Her smile on the sea is,

LXX.

INTERVAL OF THE OCTAVE.

Annie Laurie. Scotch.



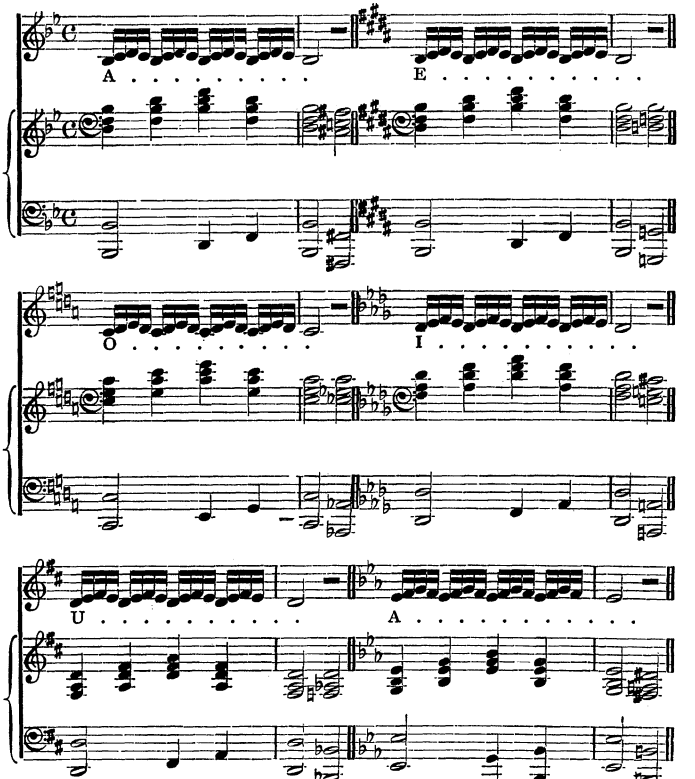
Max-well-ton braes are bon-nie, Where

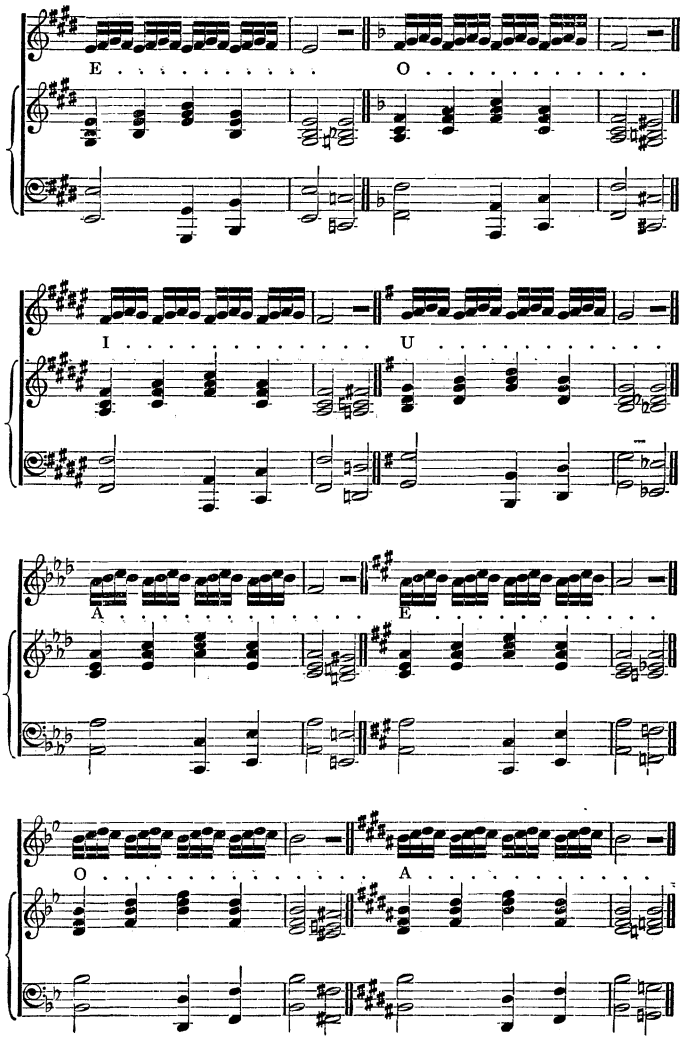
VOCAL EXERCISES

FOR ALTO, MEZZO-CONTRALTO, BASSO, AND BARITONO.

I.

EXERCISES FOR THE ACQUISITION OF FLEXIBILITY.

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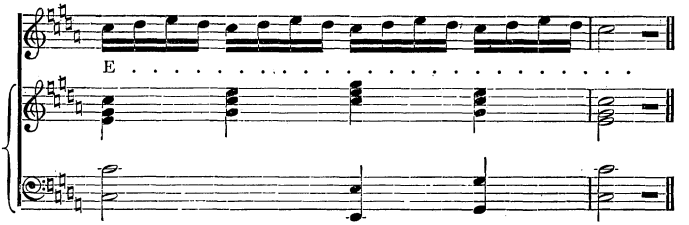
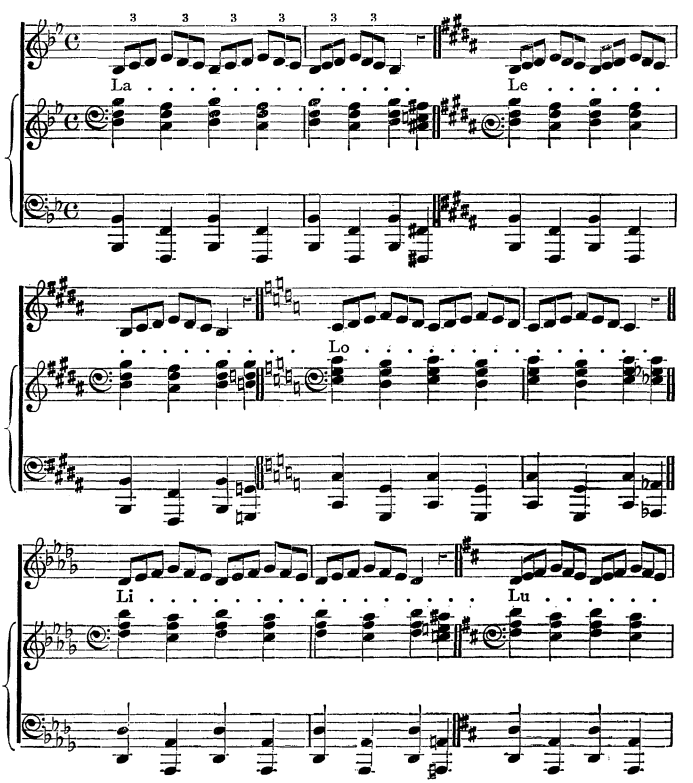
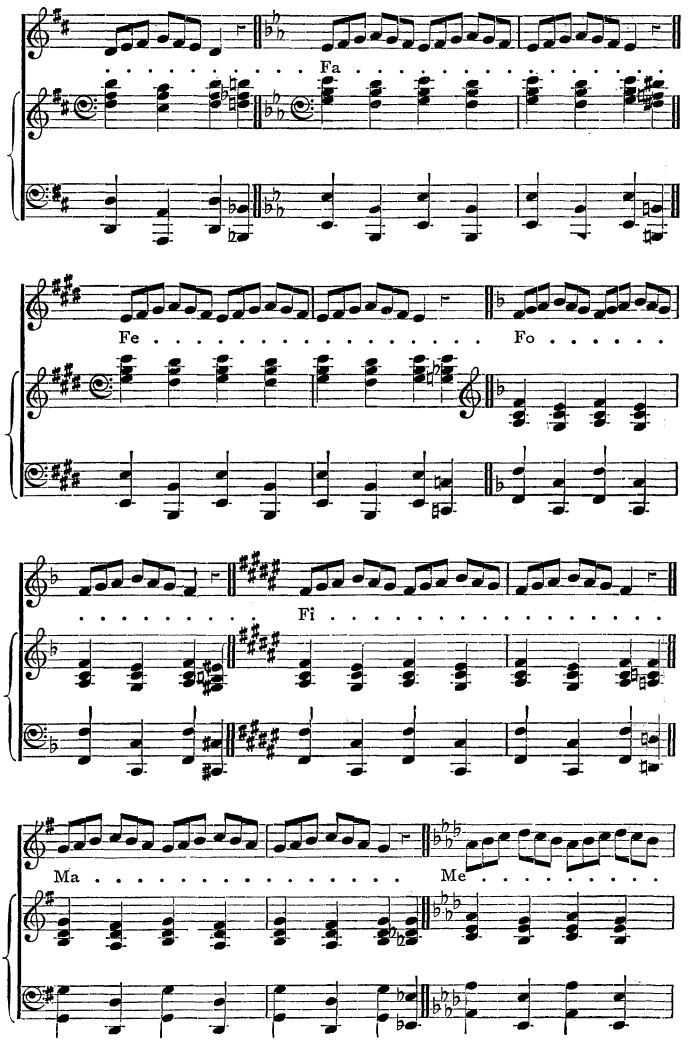
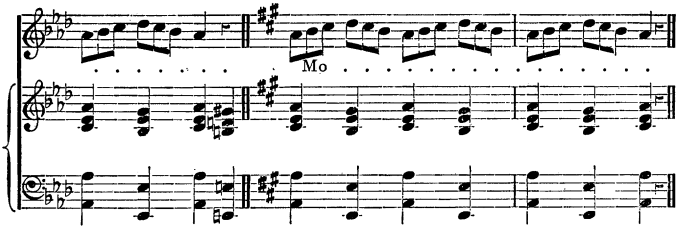


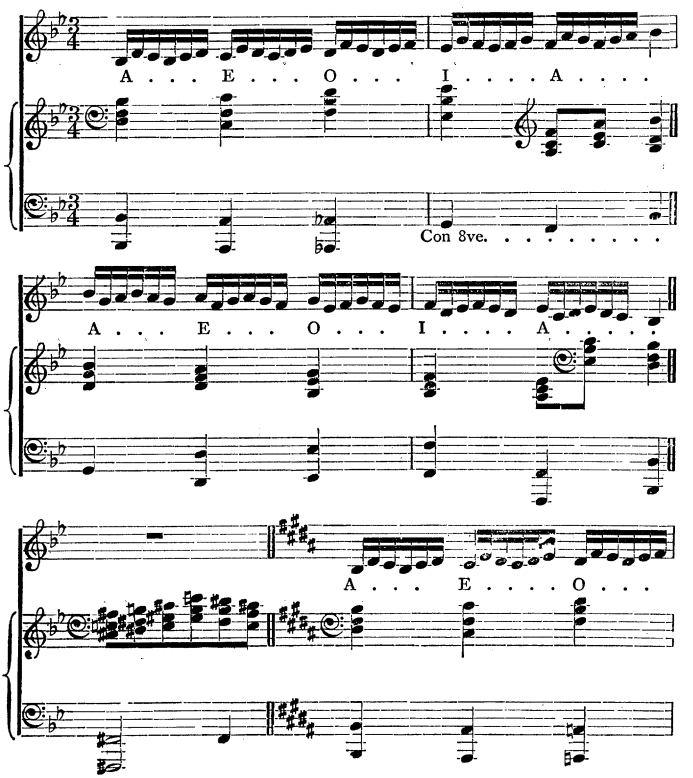
II.

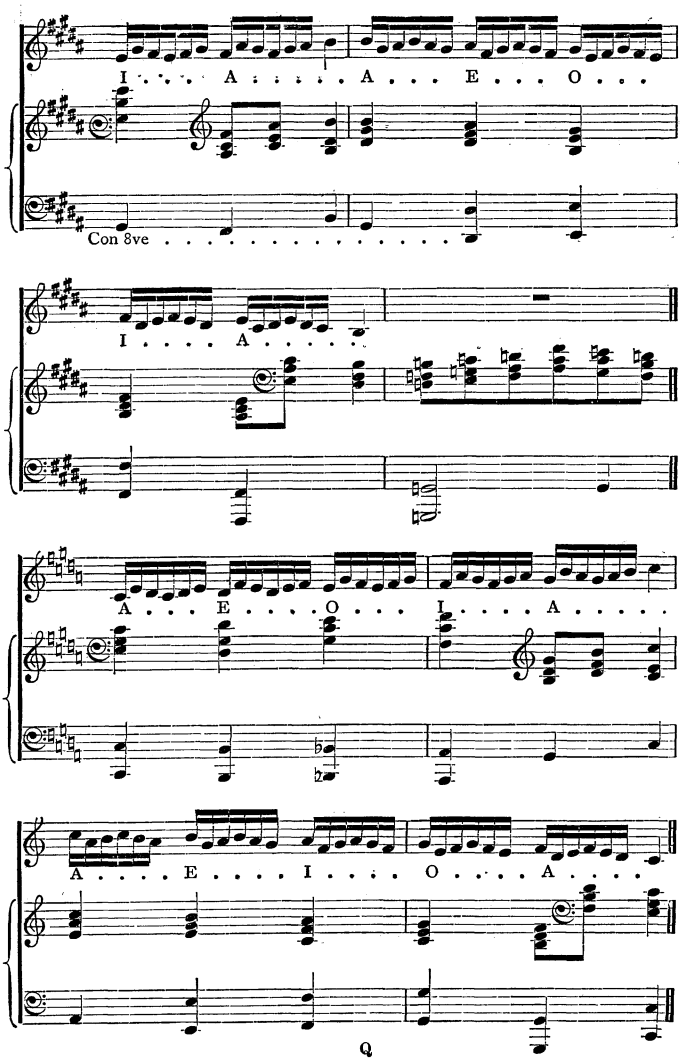



Fa
Fe
Fo
Fi
Ma
Me



III.

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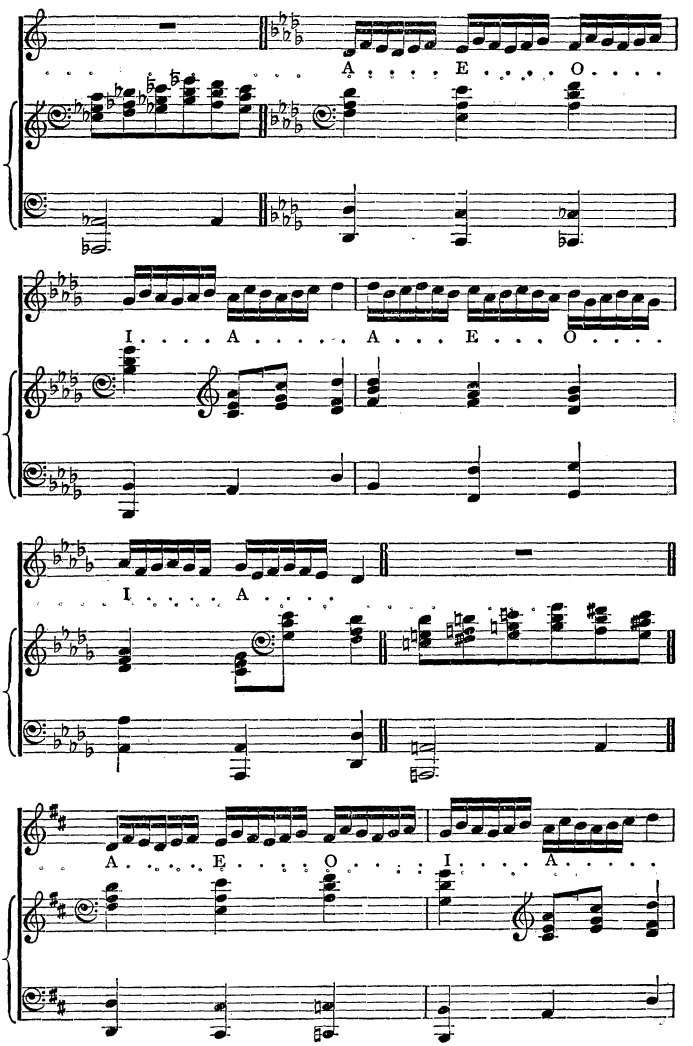
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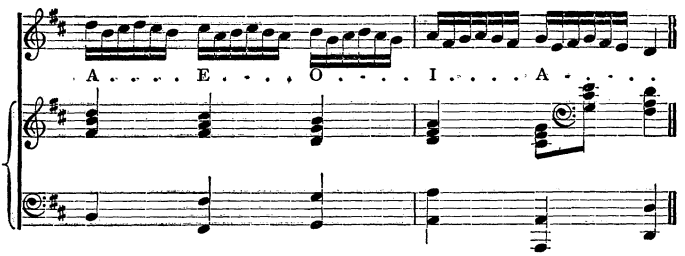

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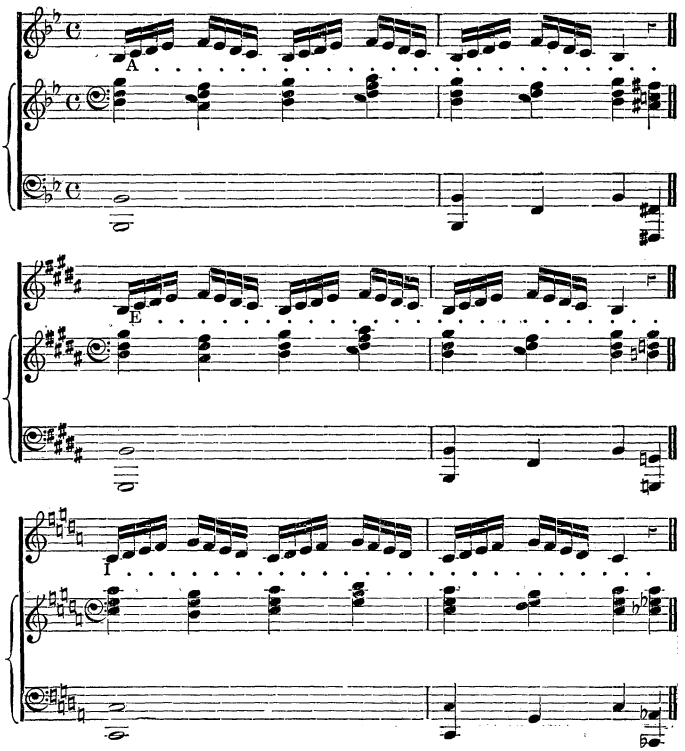

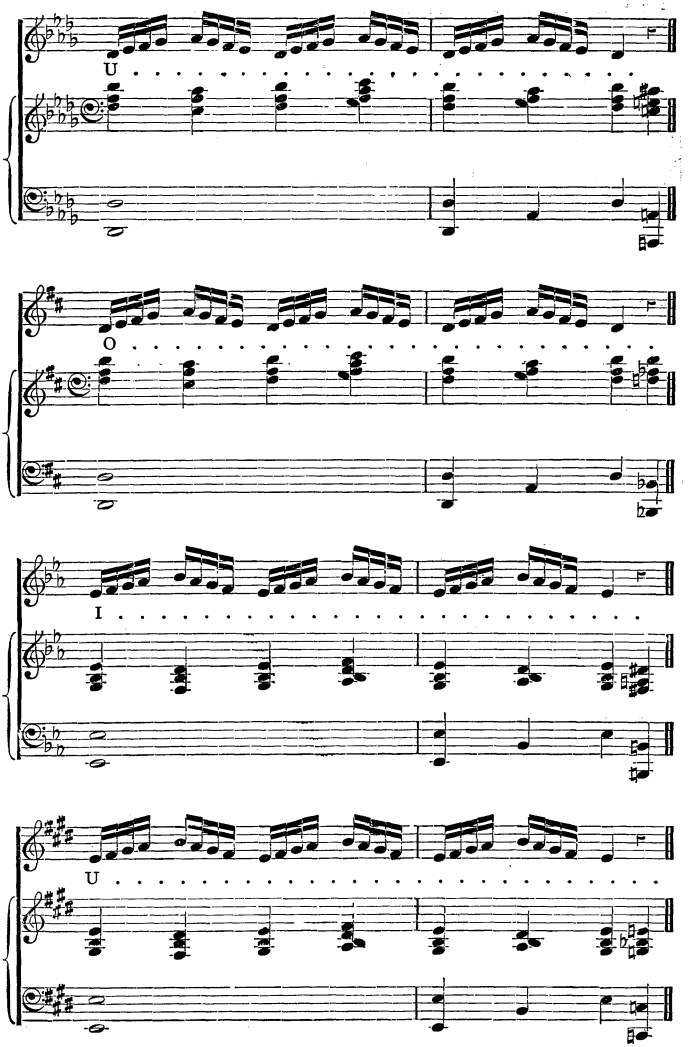
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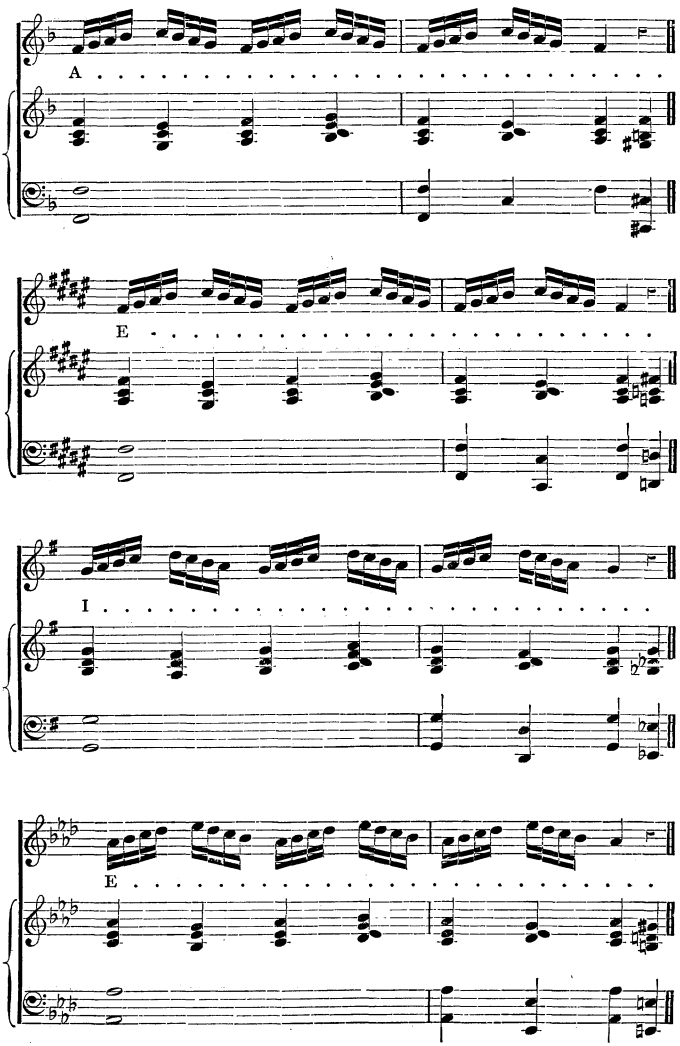
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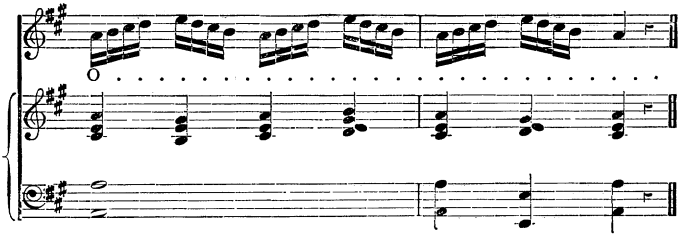

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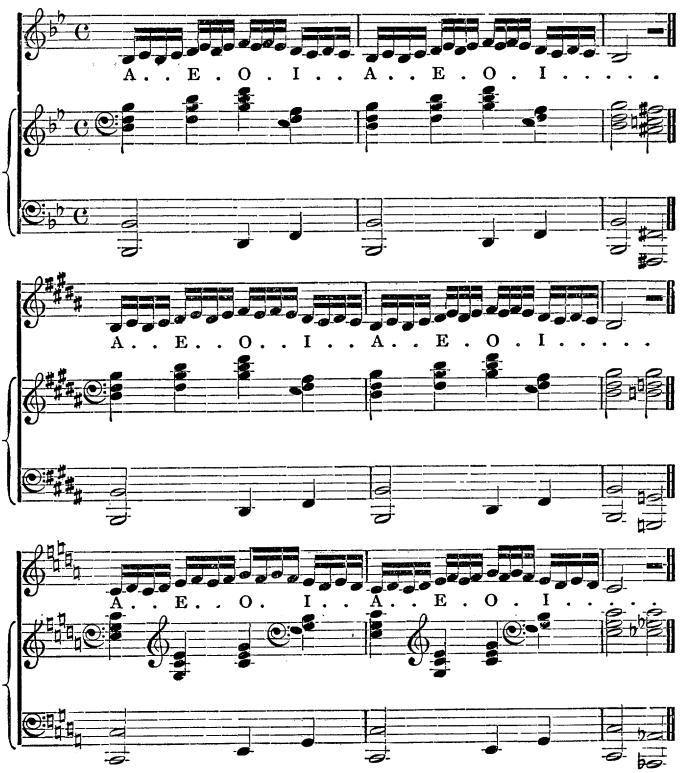

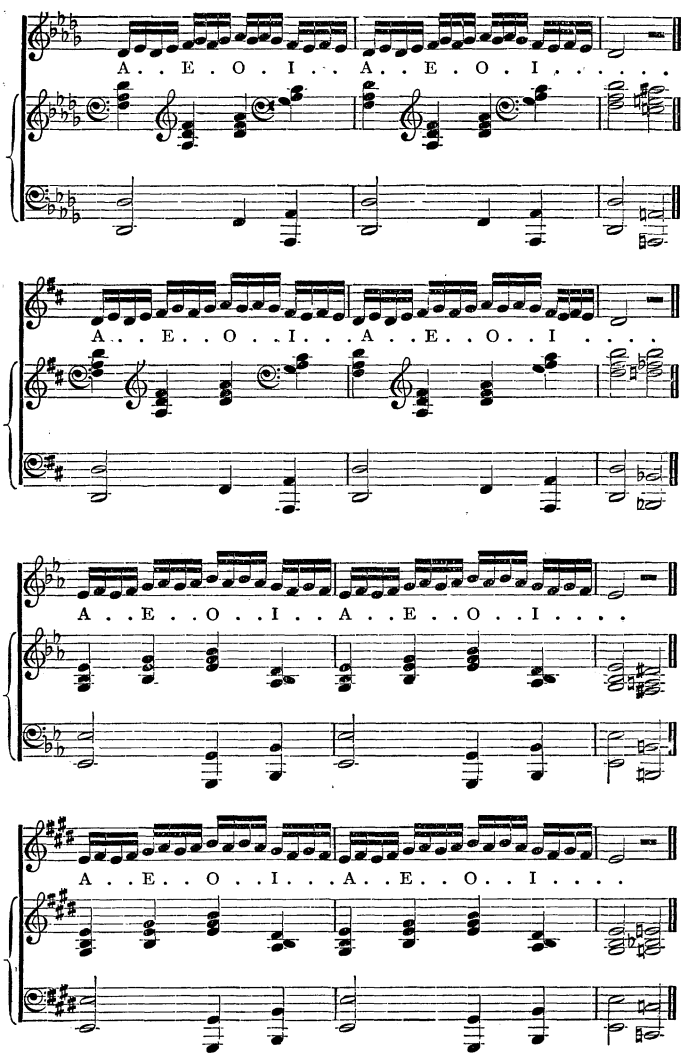
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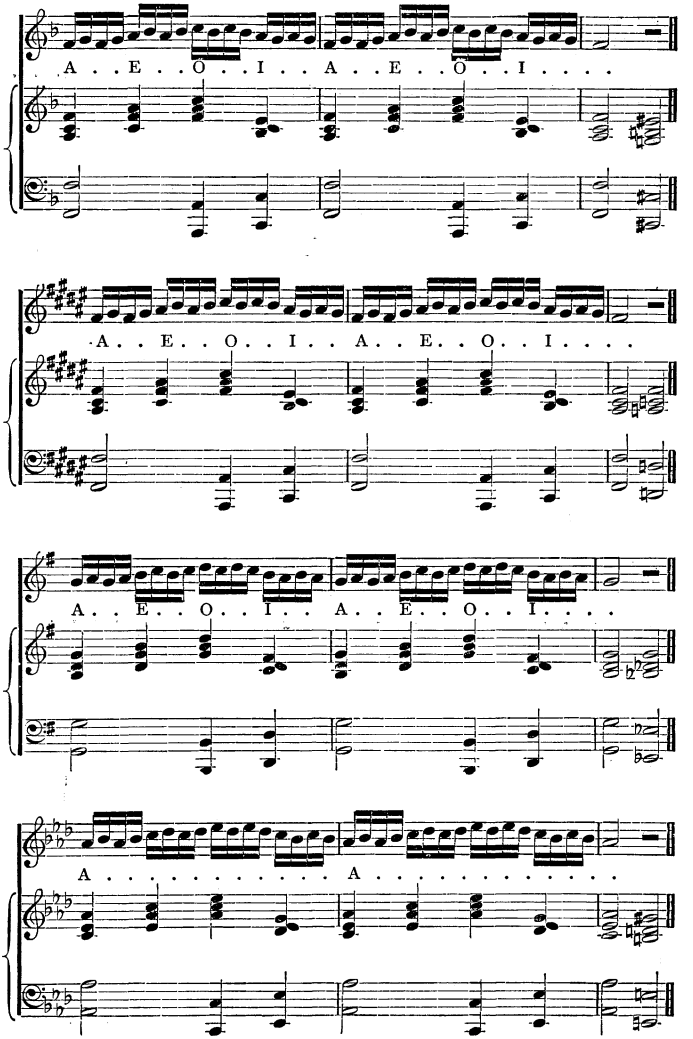
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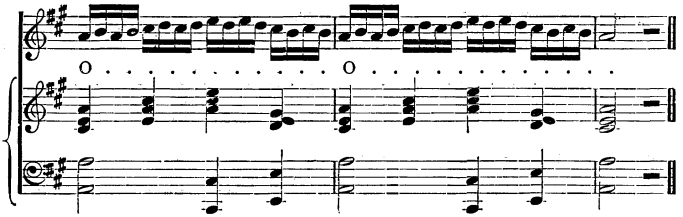
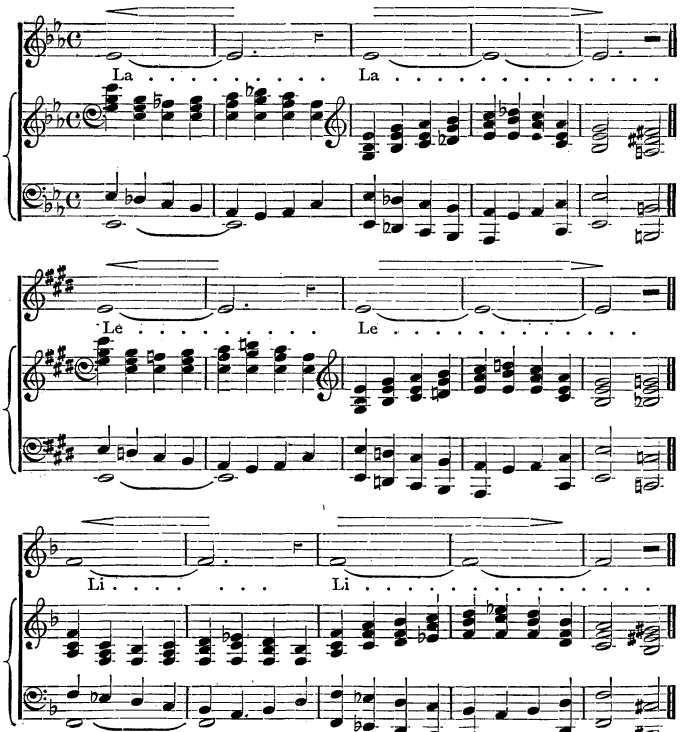
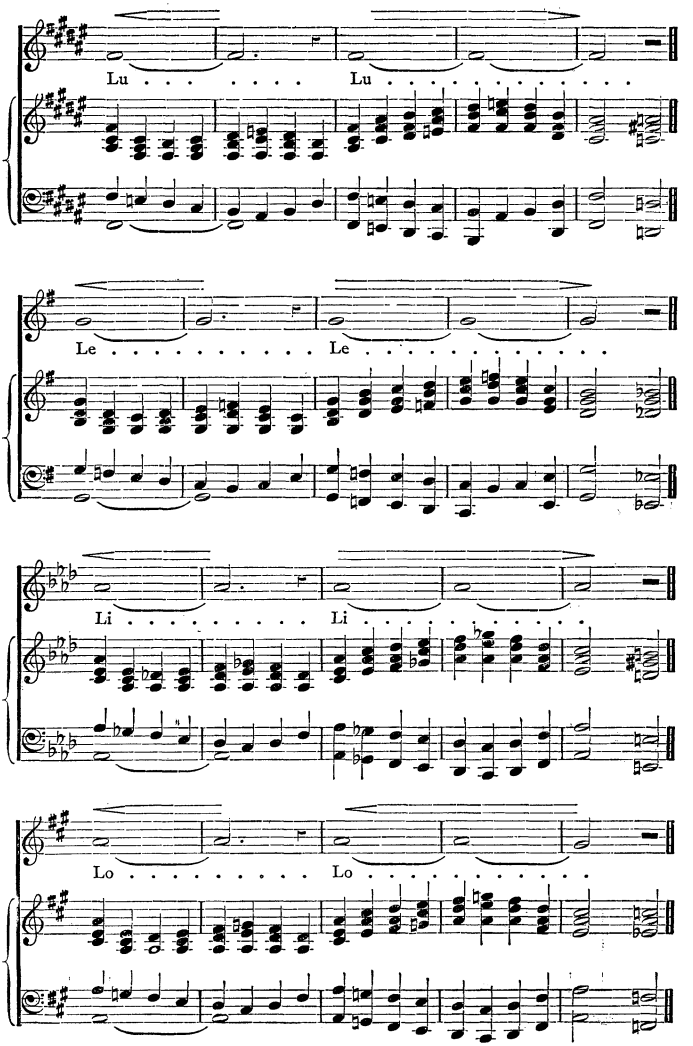
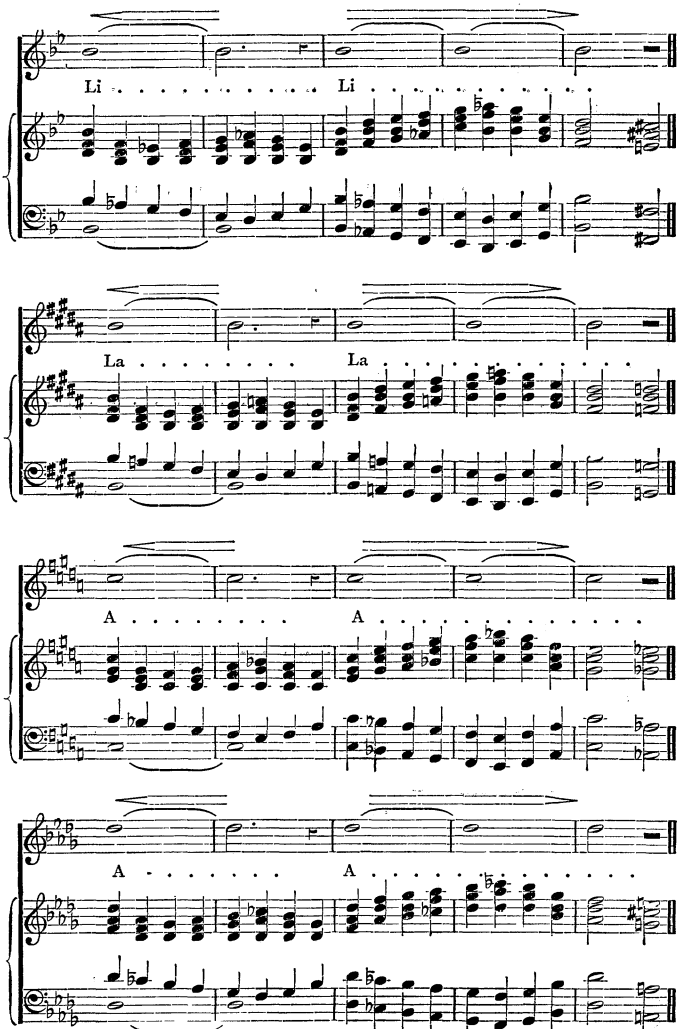


VI.

PREPARATORY EXERCISE FOR MESSA DI VOCE.




Lu . . . . . Lu . . . . . .
Le . . . . . Le . . . . . .
Li . . . . . Li . . . . . .
Lo . . . . . Lo . . . . . .


Li . . . . . Li . . . . . .
La . . . . . La . . . . . .
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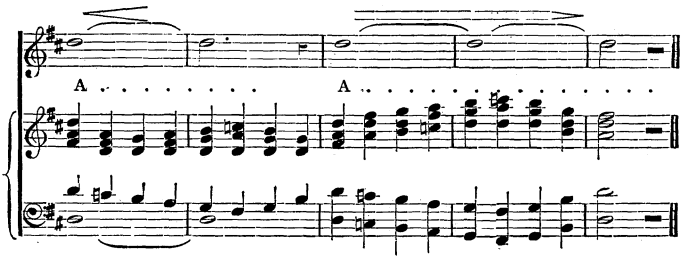
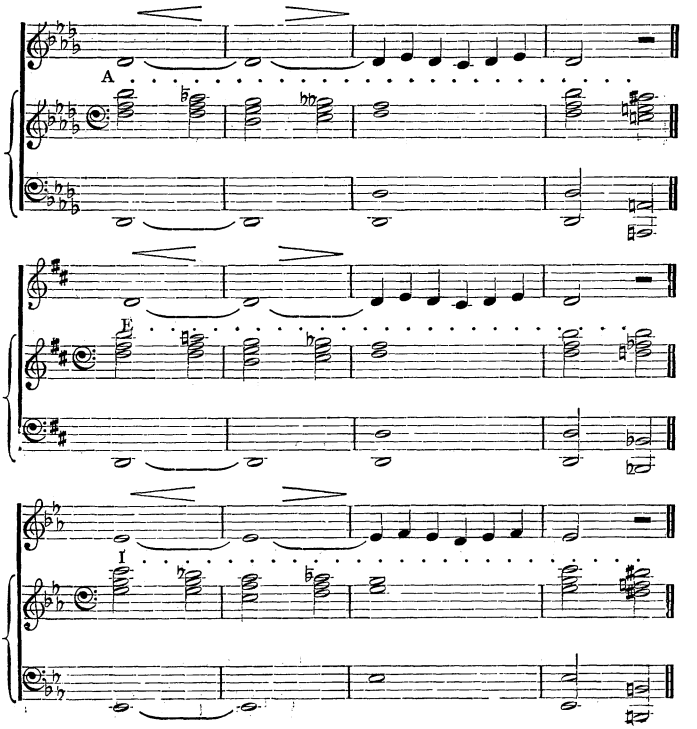
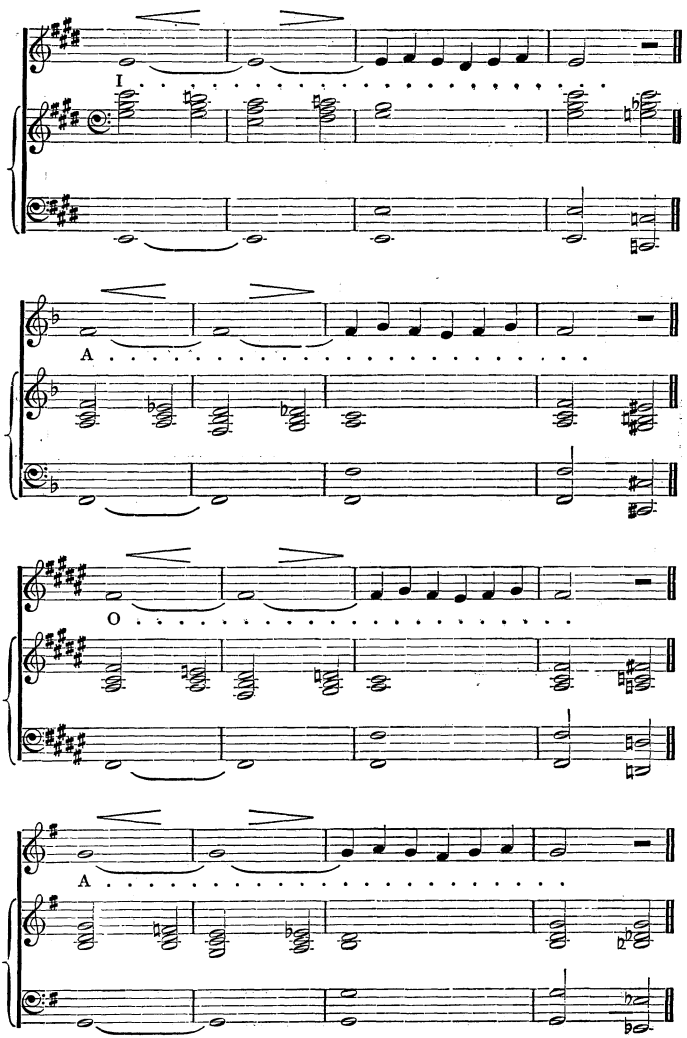
A . . . . . A . . . . . .



VII.

MESSA DI VOCE, WITH MORDENTE.

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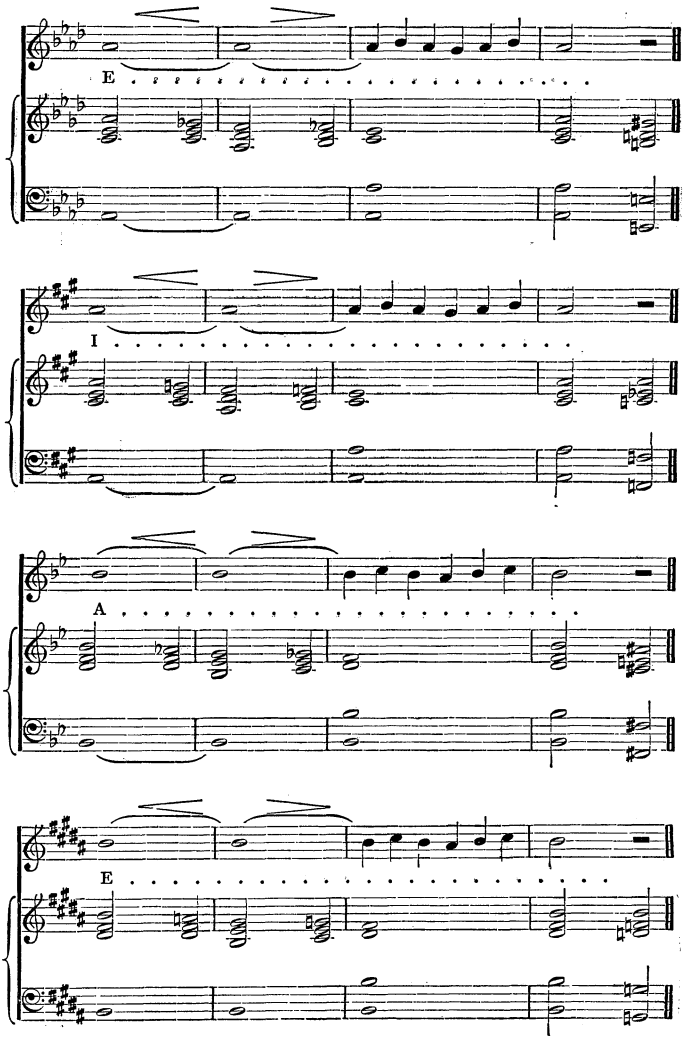
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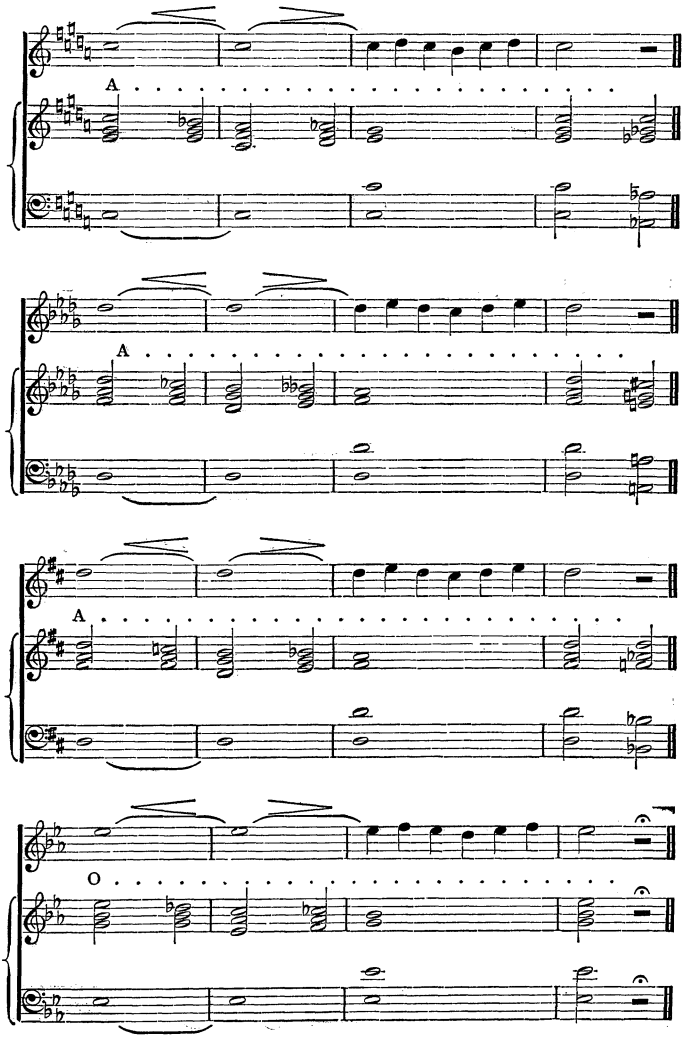
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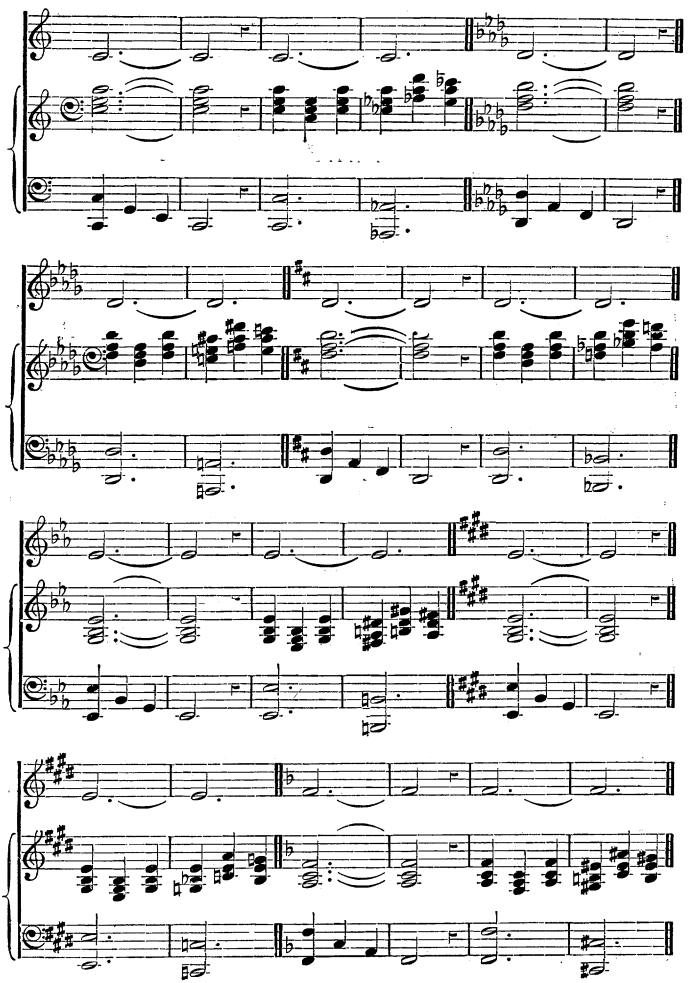
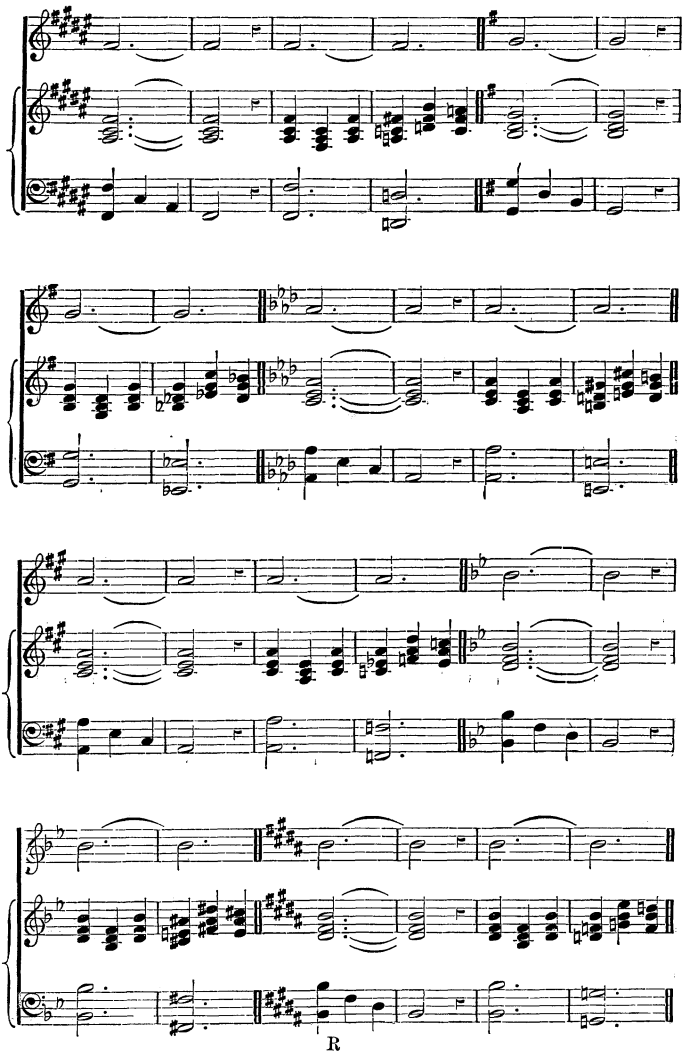
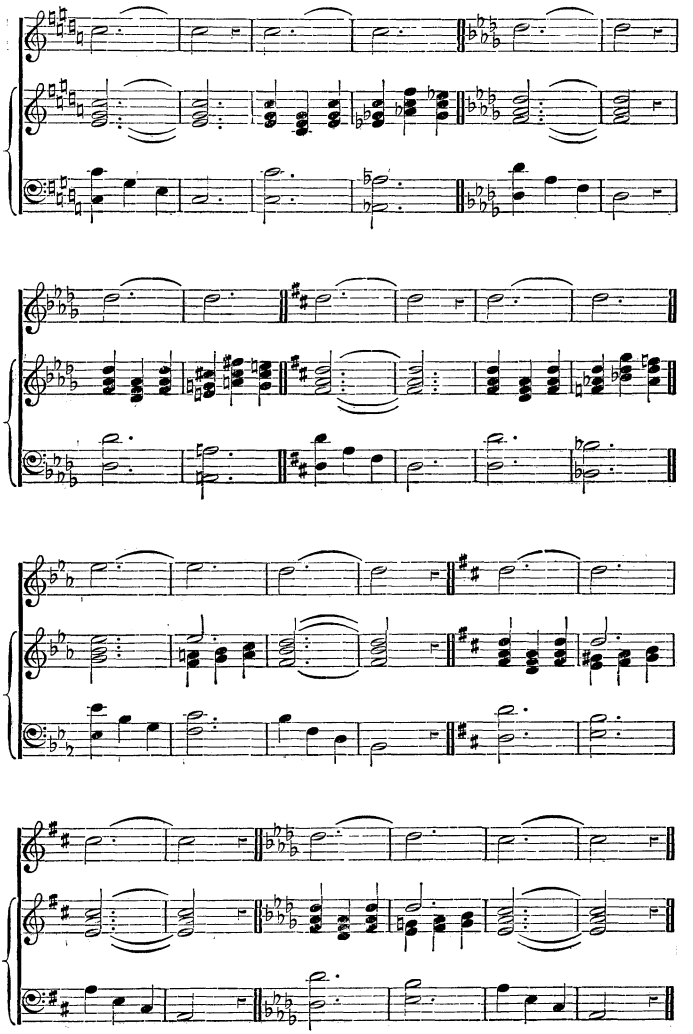
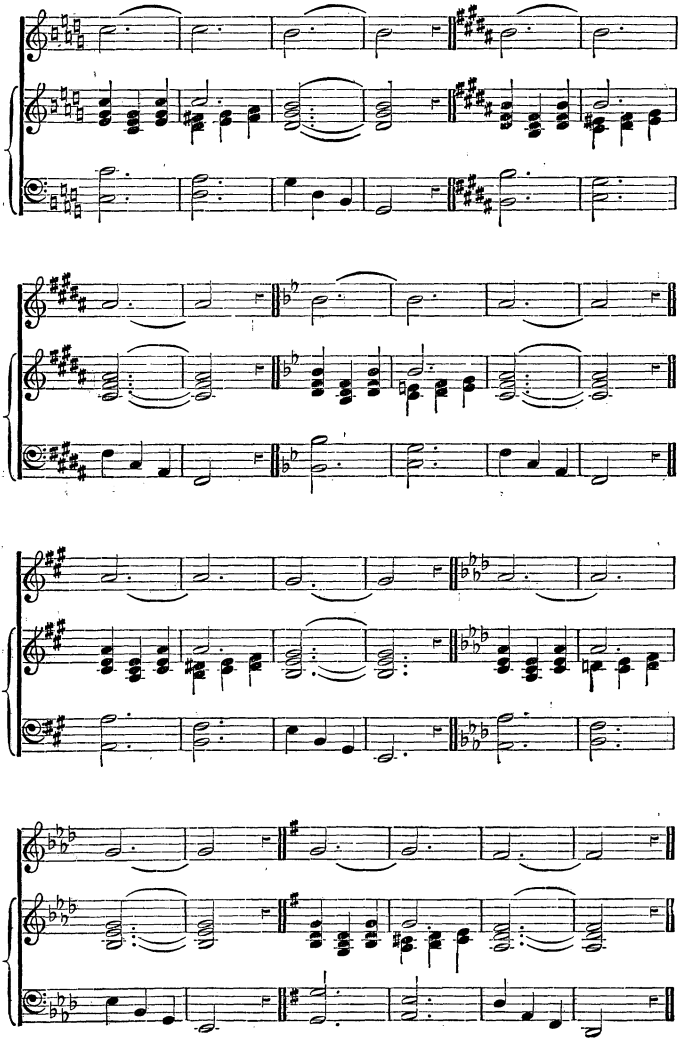
VIII.

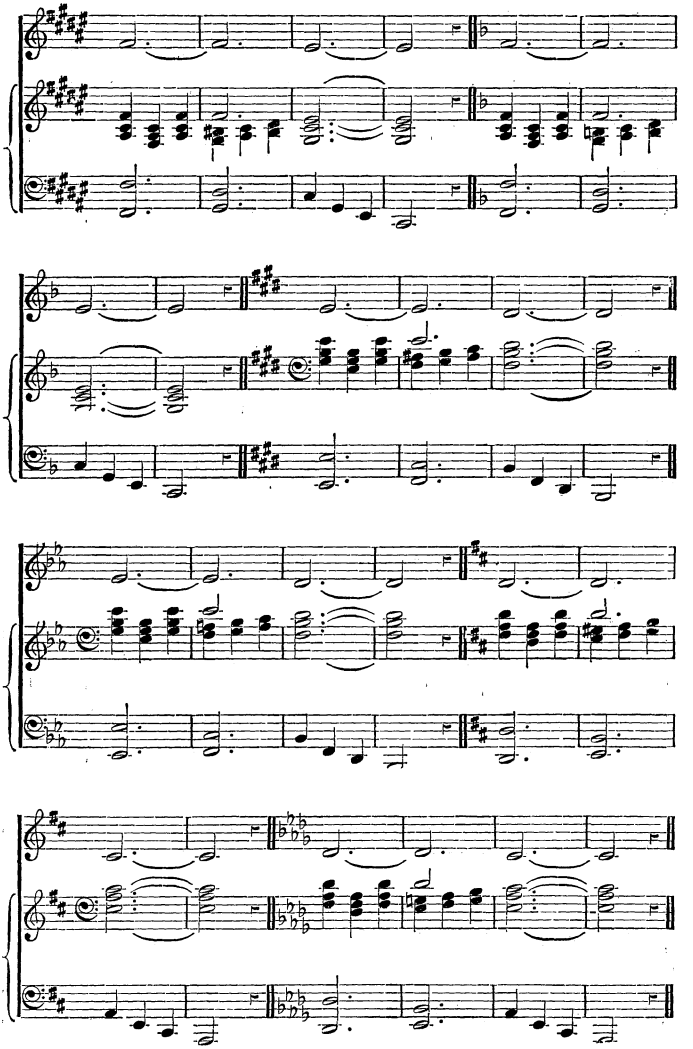
MESSA DI VOCE CHROMATIC PROGRESSION.





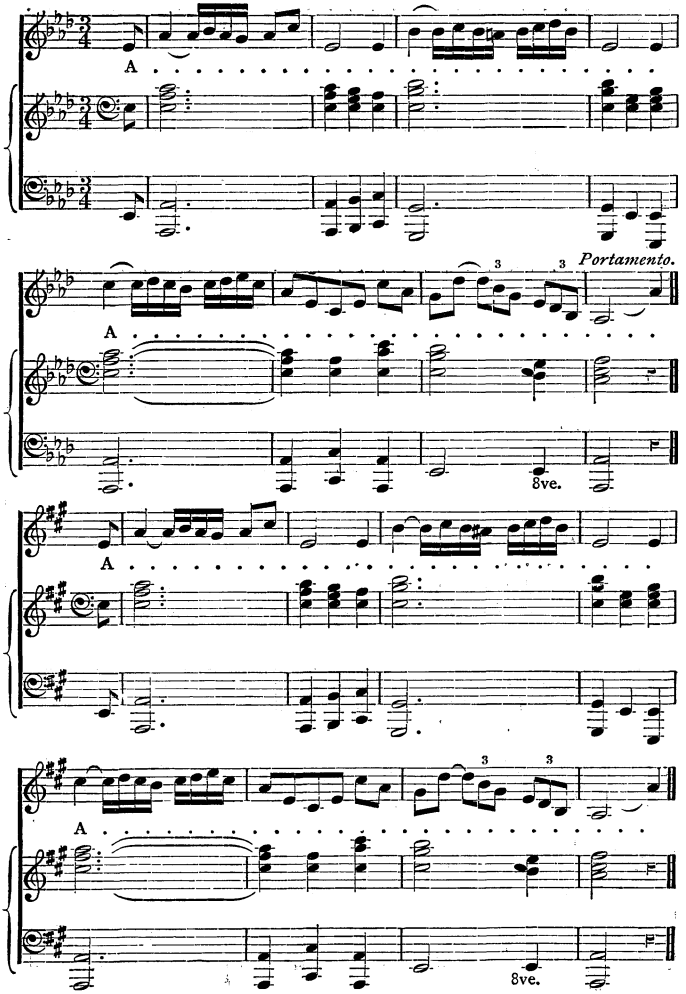


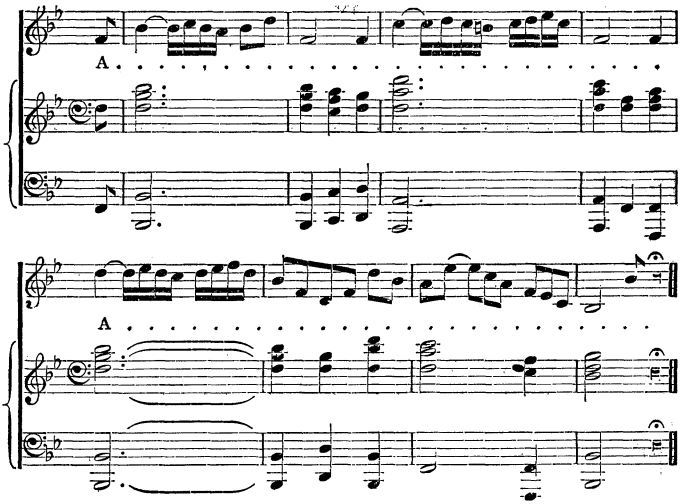




IX.

PORTAMENTO DI VOCE.





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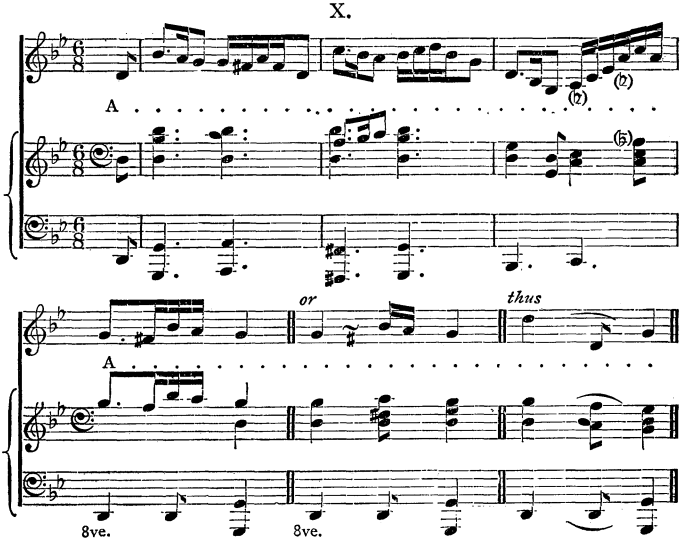

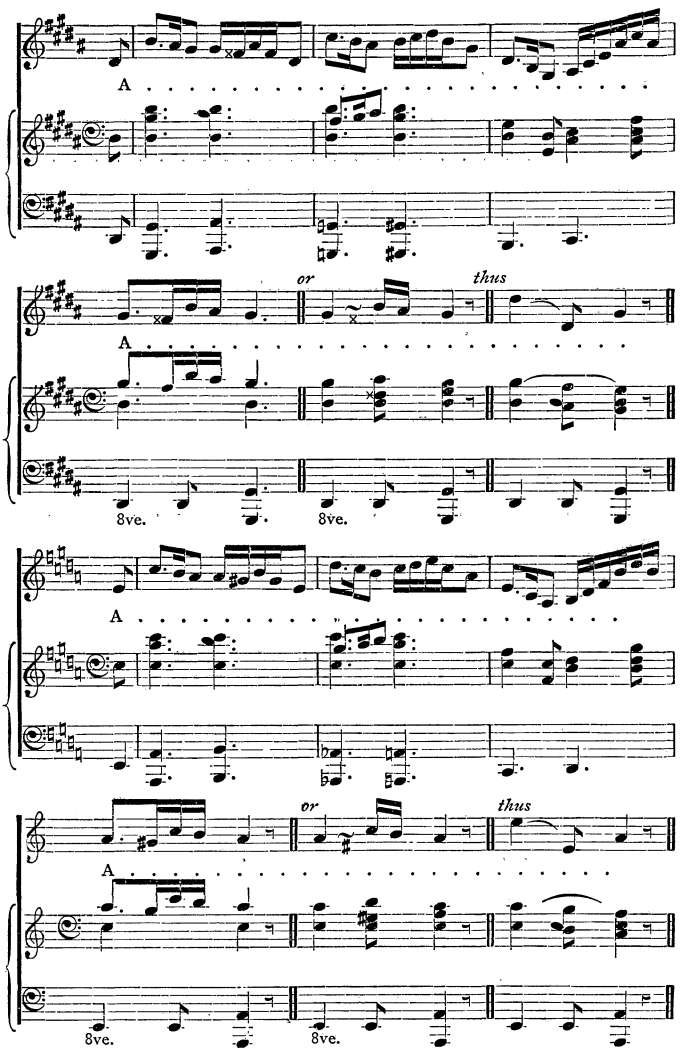
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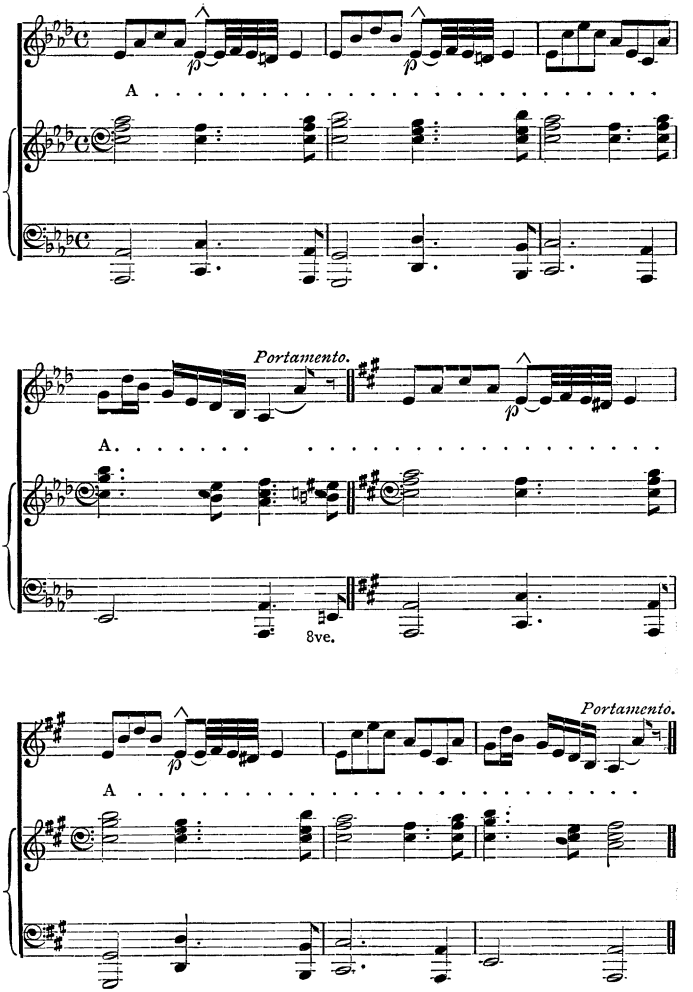
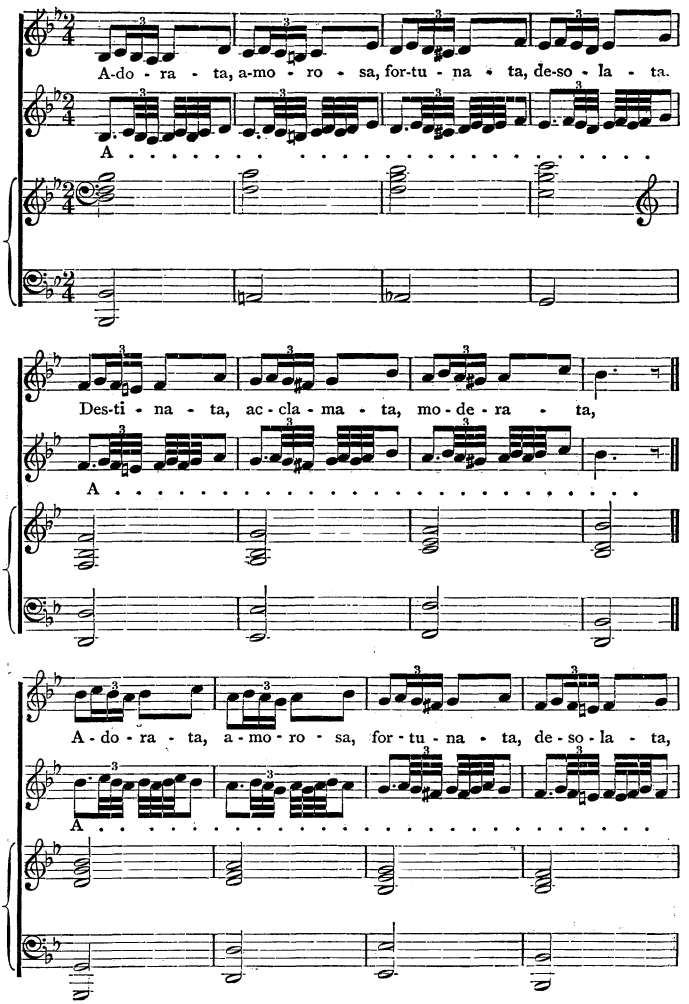
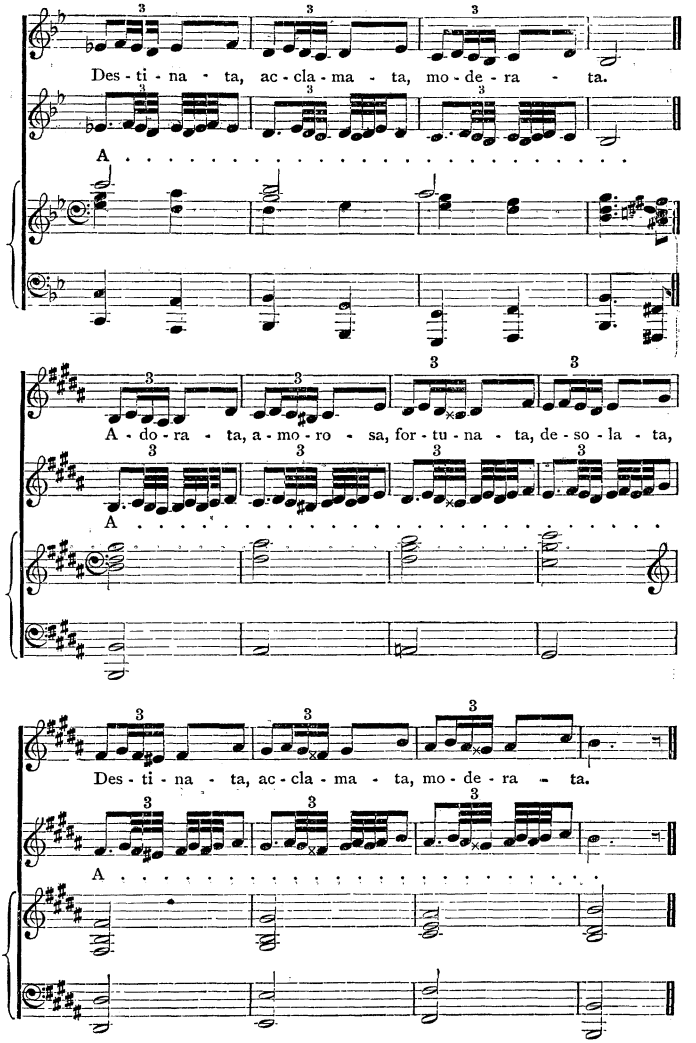


XII.

MORDENTE.




Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta.
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A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta.
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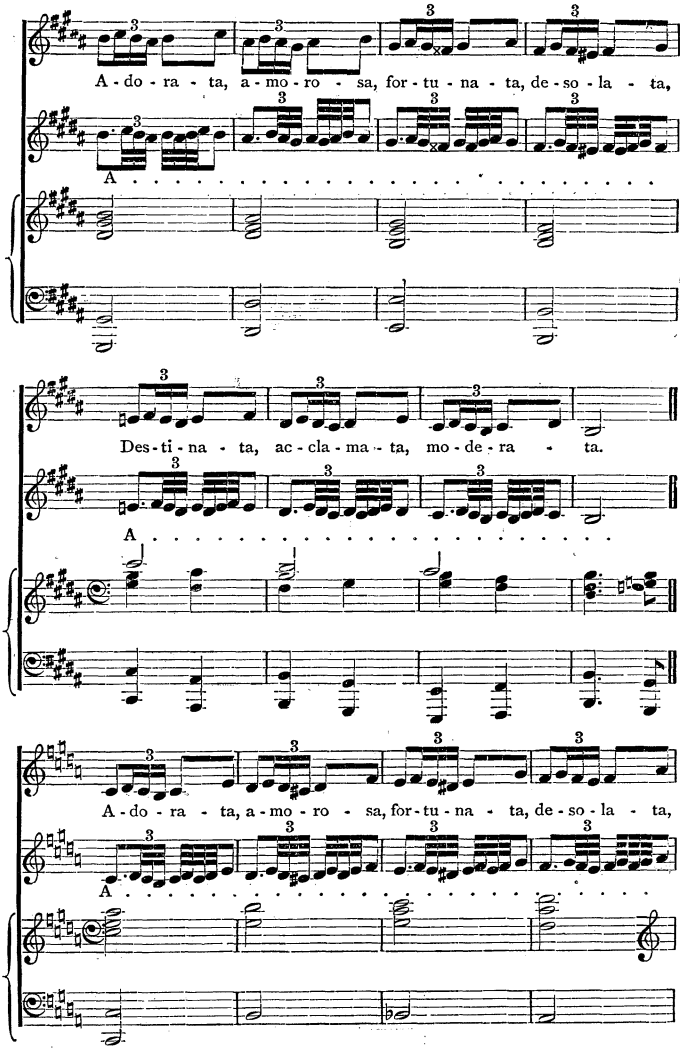
A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta.
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A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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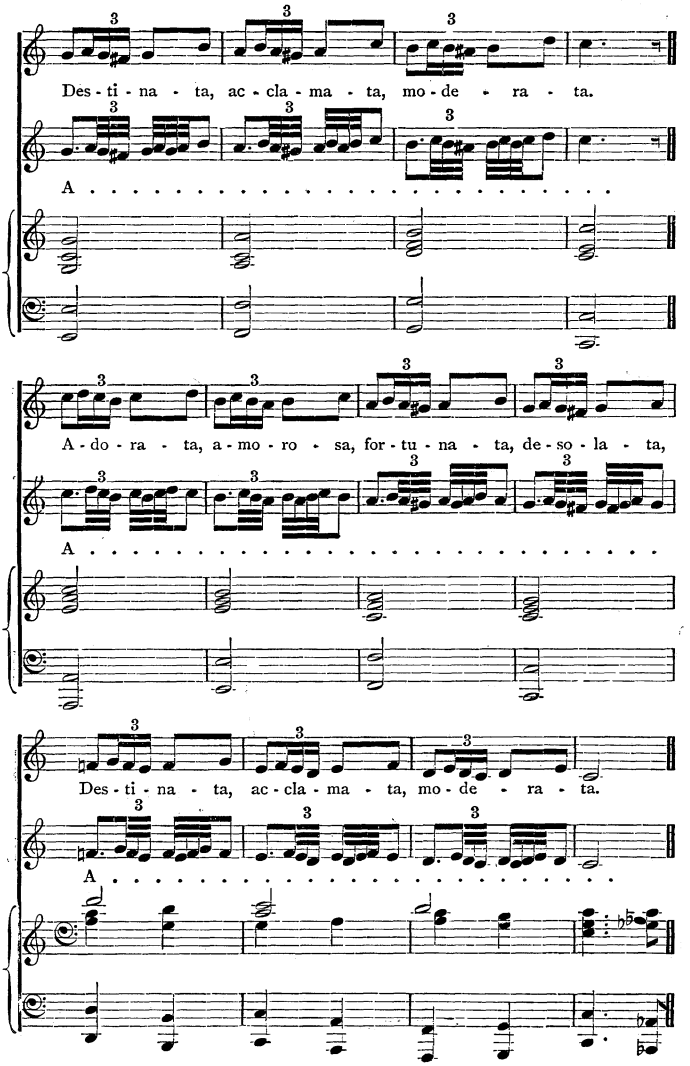
Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta.
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A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta.
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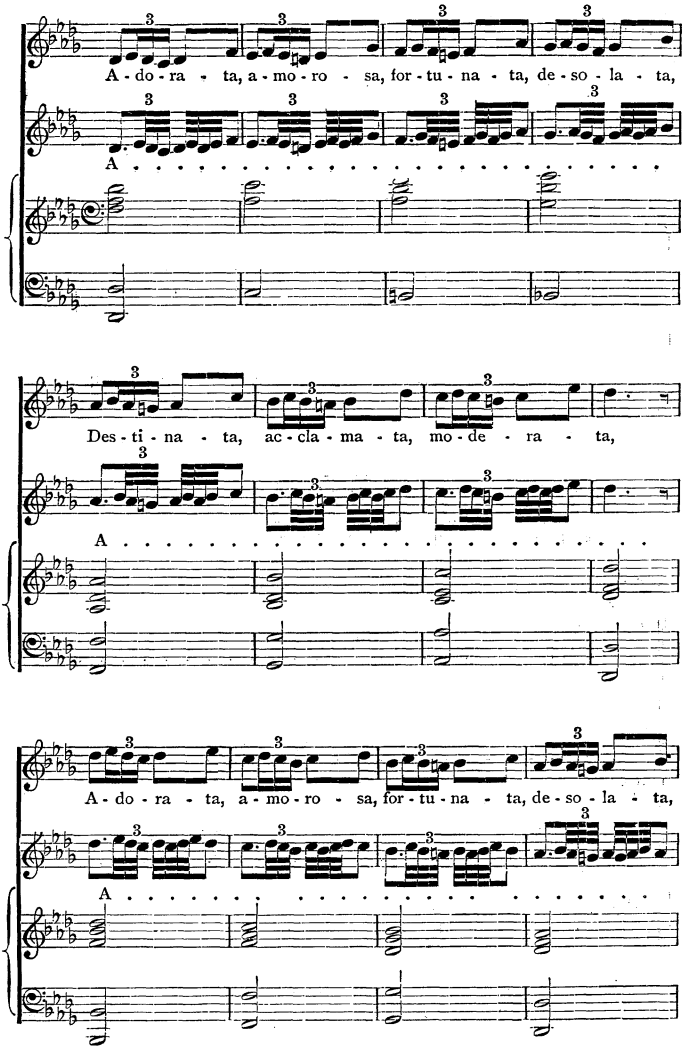
A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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Des - ti - na - ta, ac - cla - ma - ta, mo - de - ra - ta,
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A - do - ra - ta, a - mo - ro - sa, for - tu - na - ta, de - so - la - ta,
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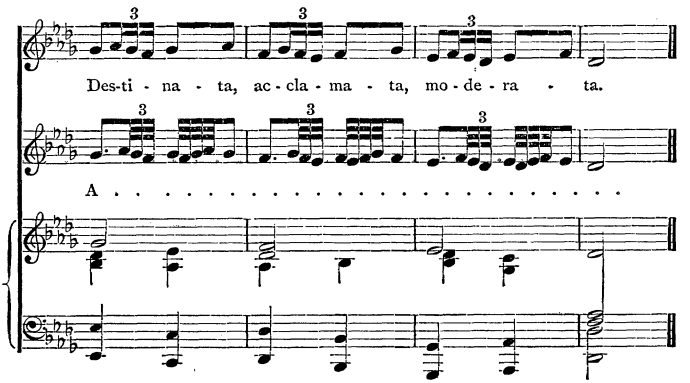
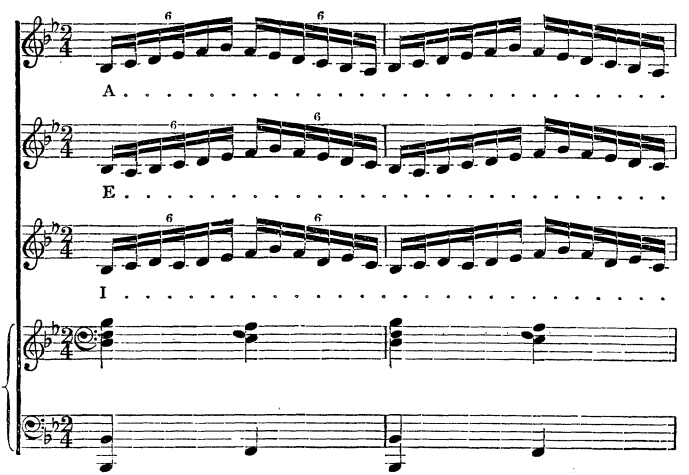
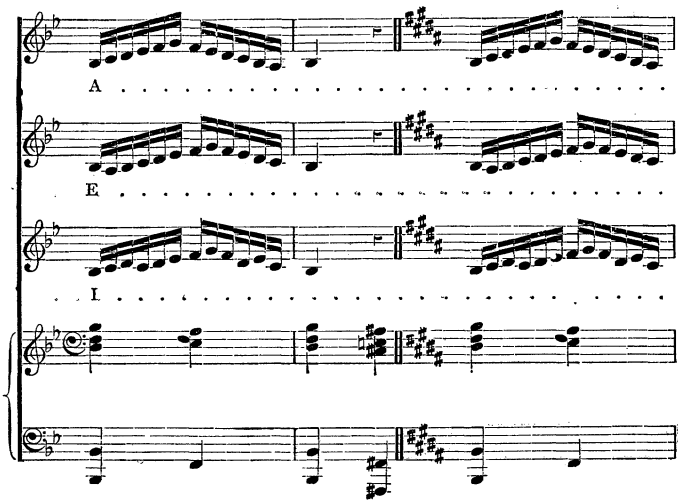


XIII.

EXERCISES FOR THE ACQUISITION OF FLEXIBILITY.

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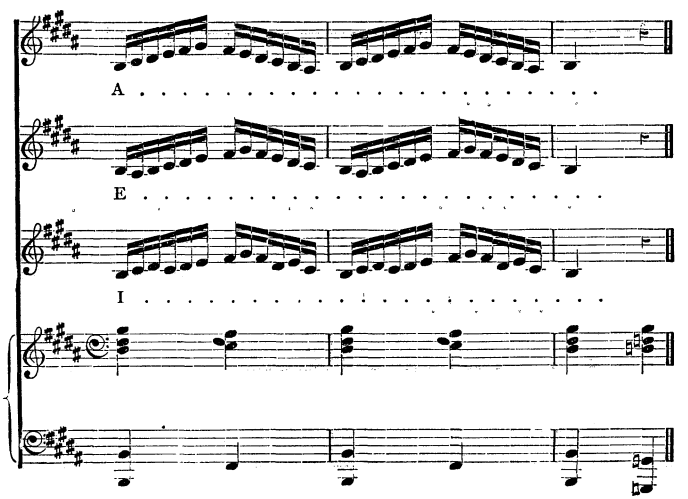
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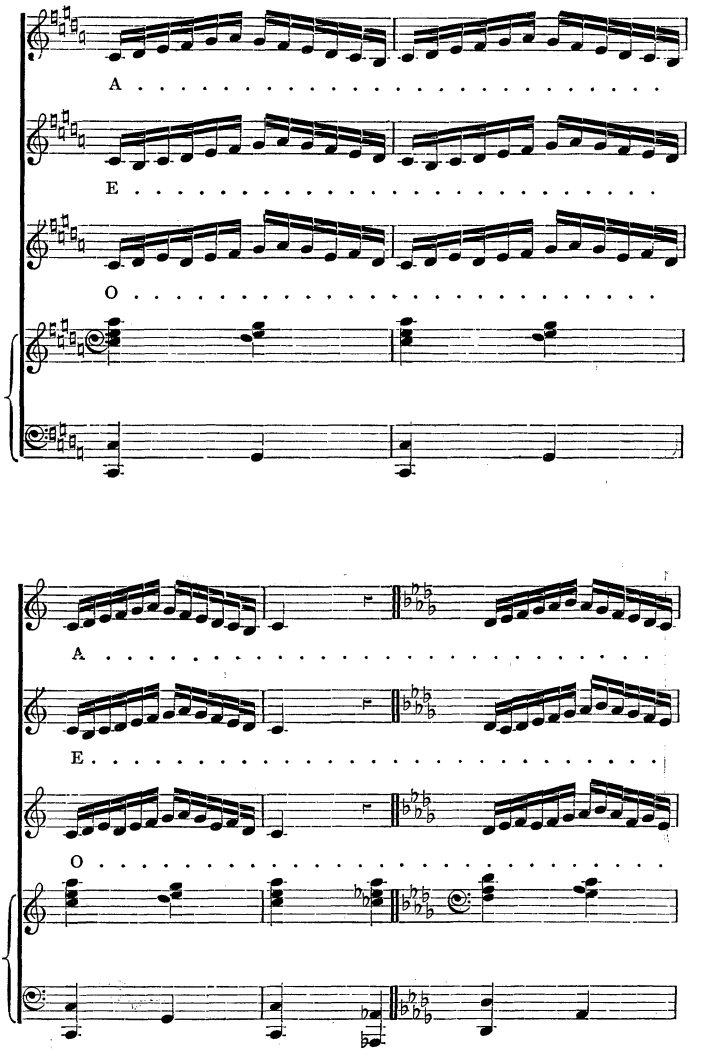
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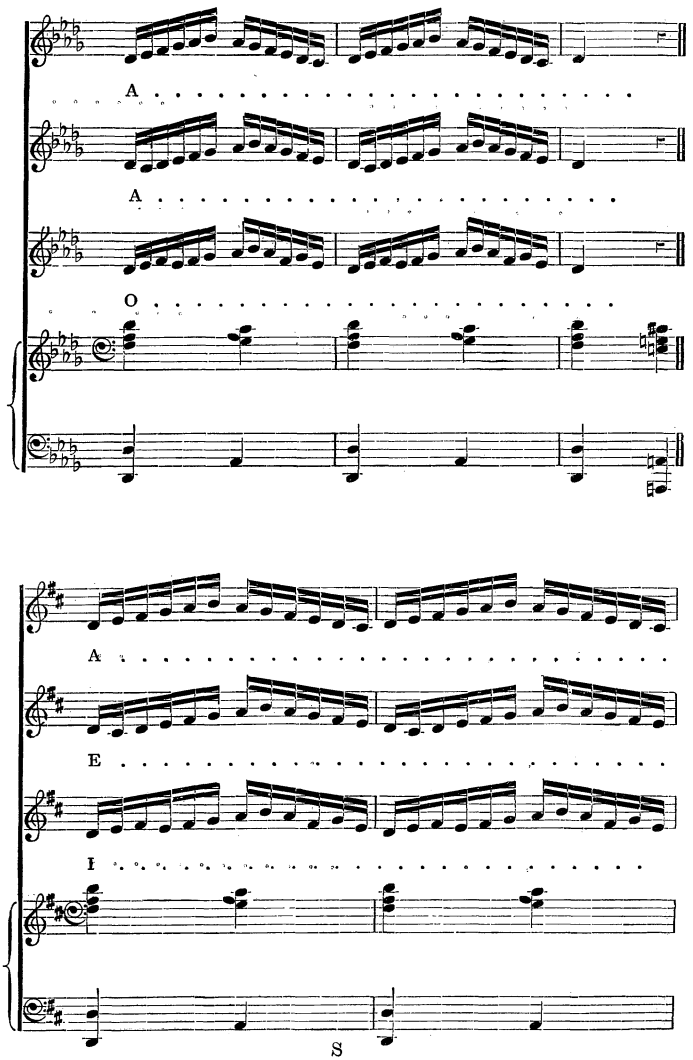
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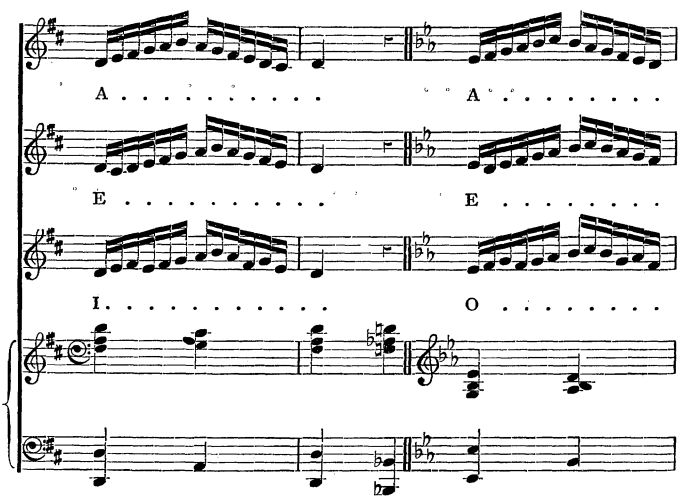
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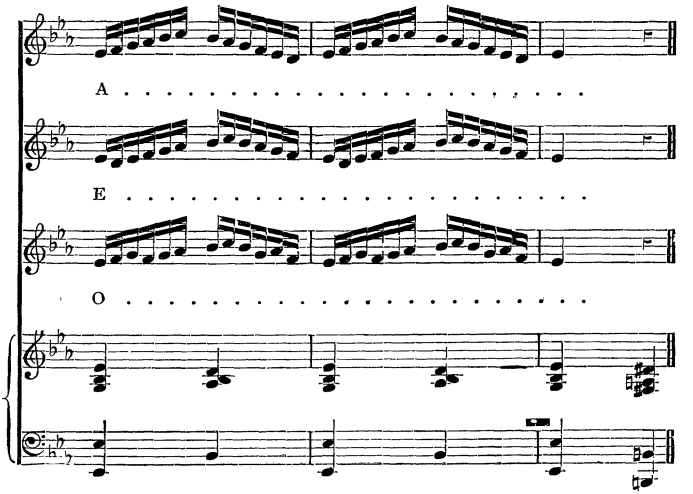
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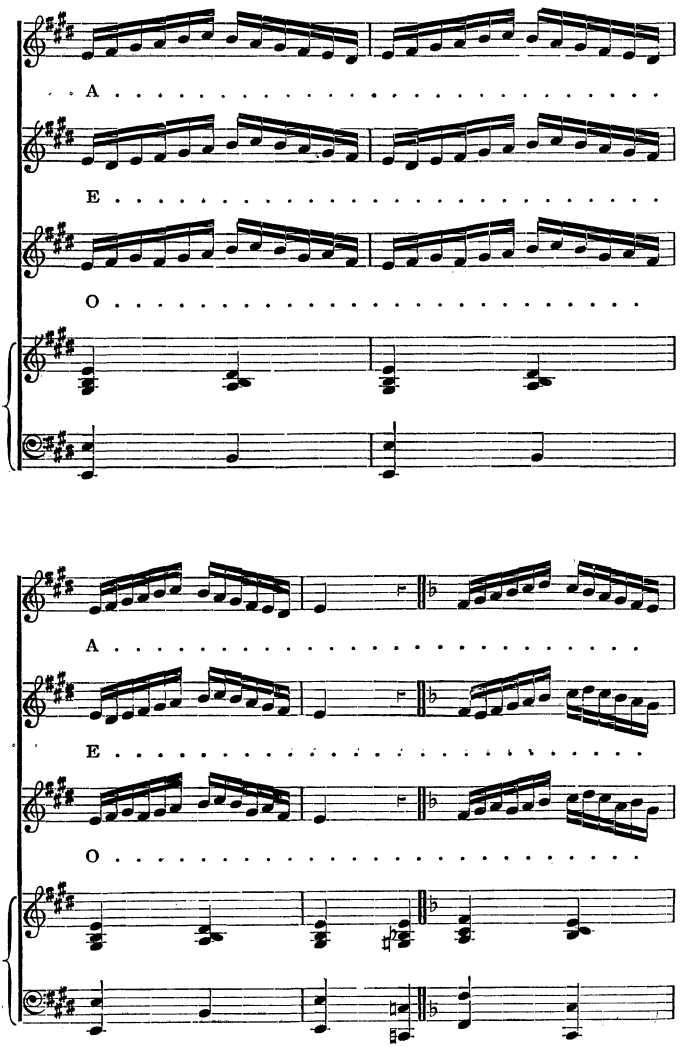
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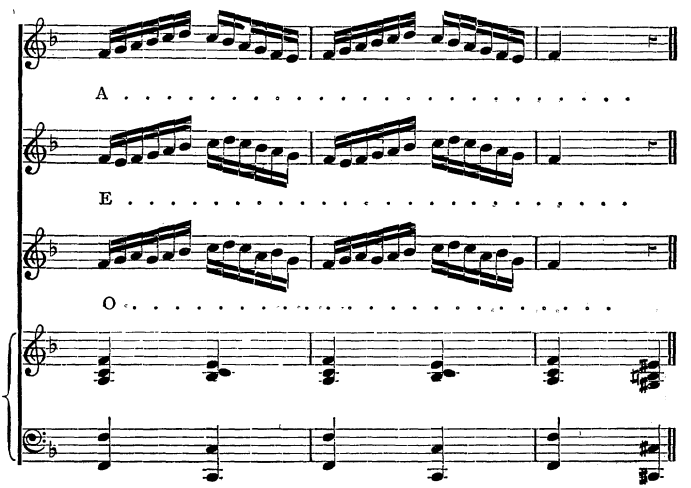
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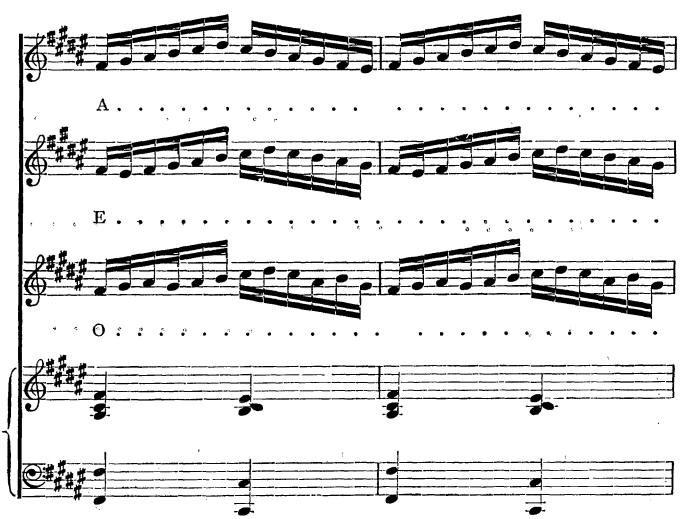
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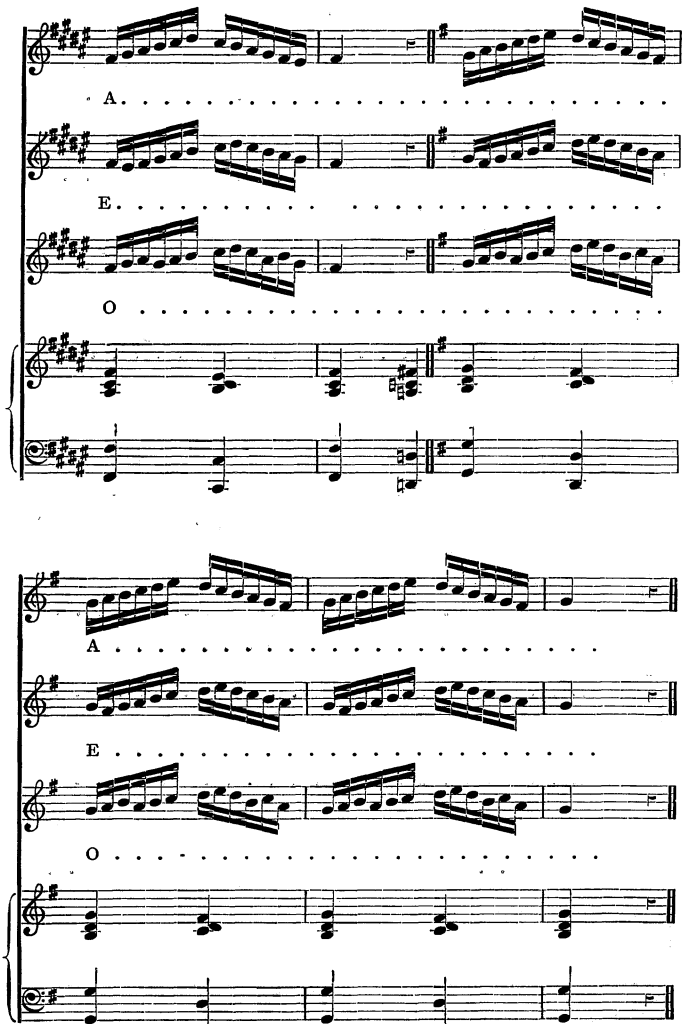
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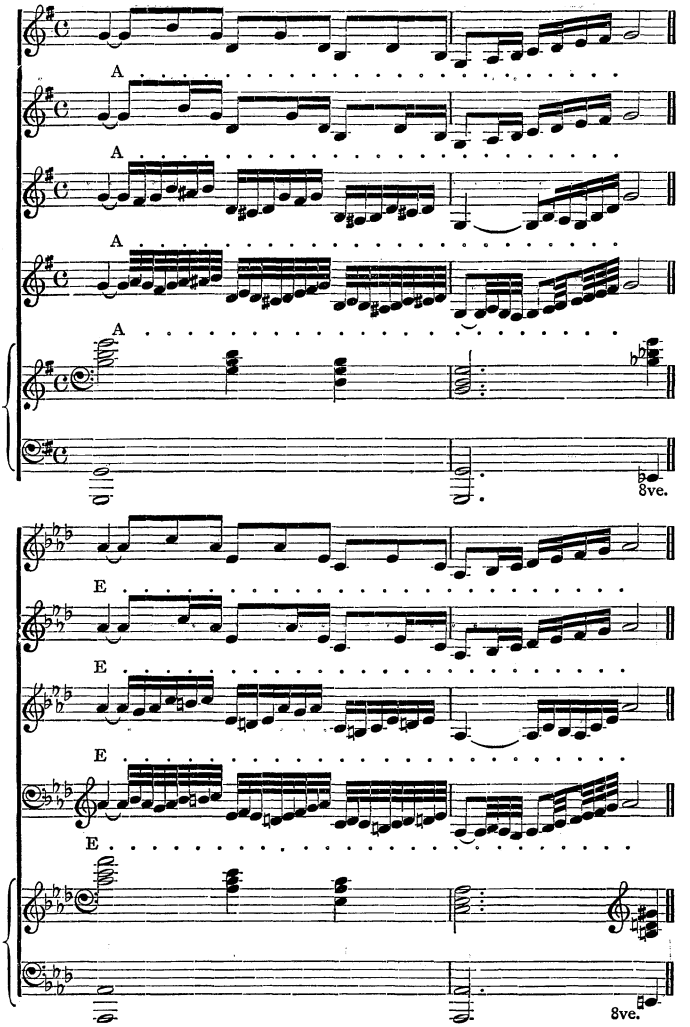
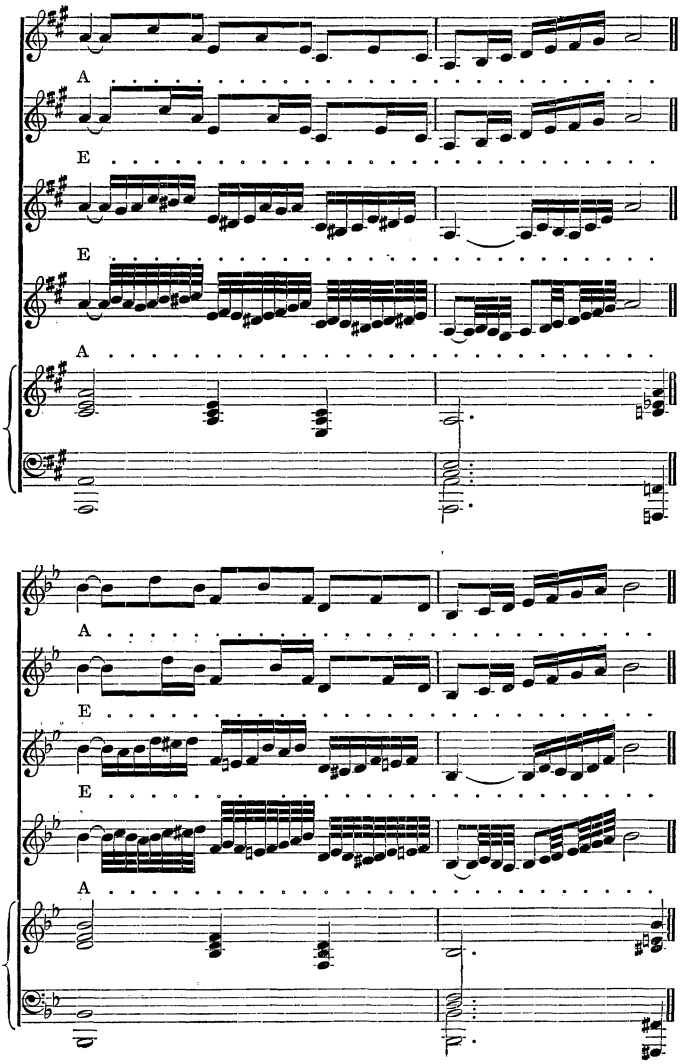
XIV.

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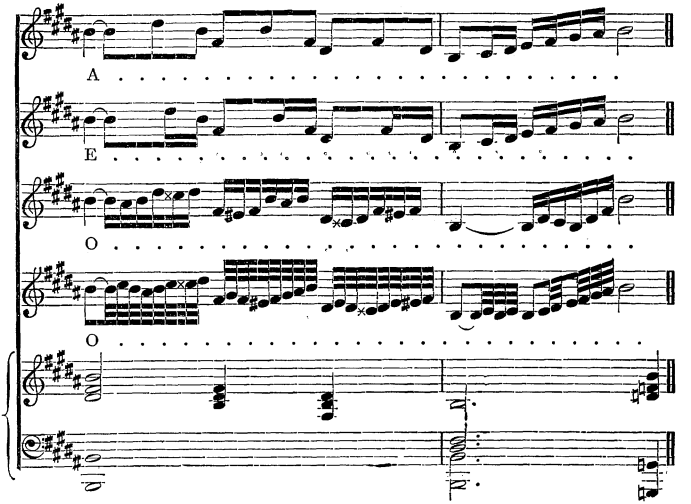
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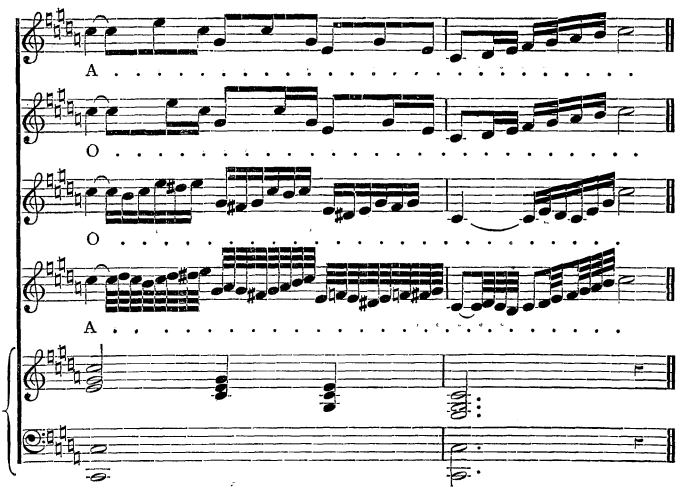
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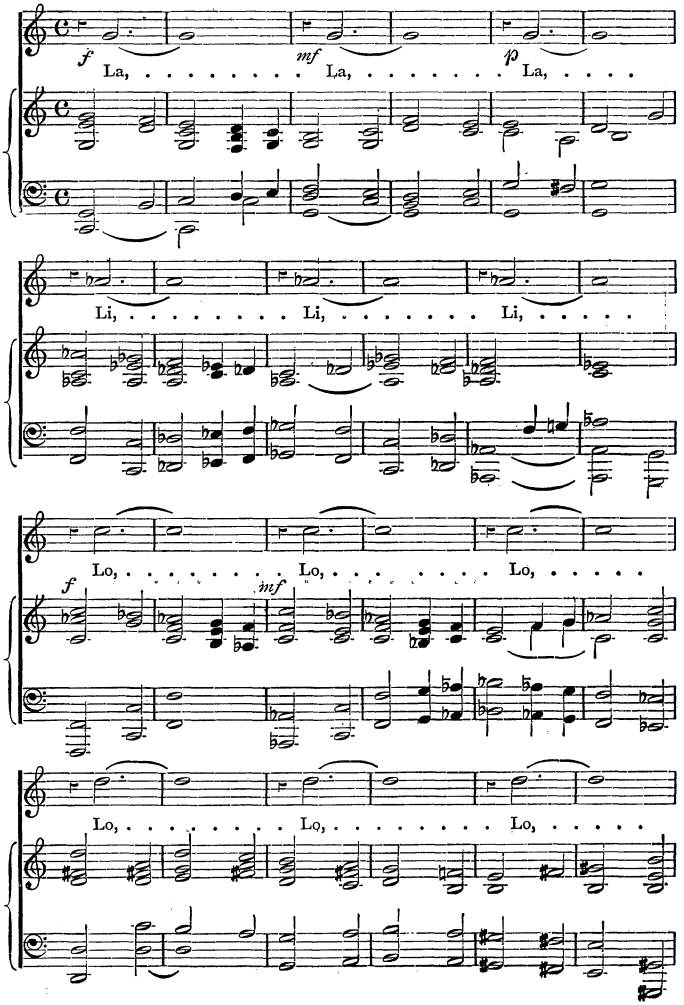
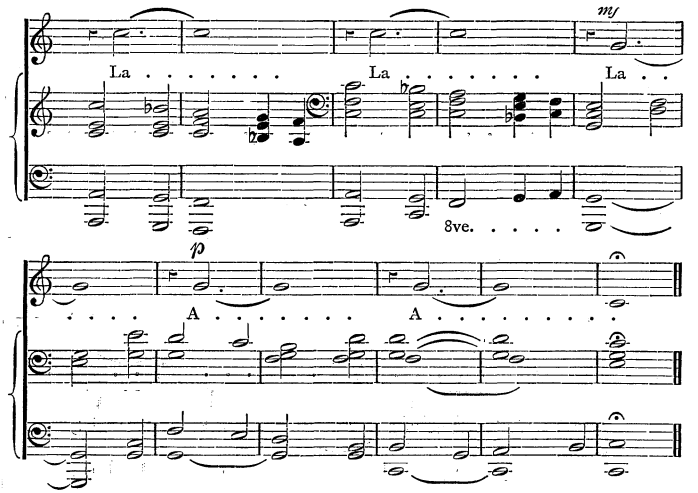
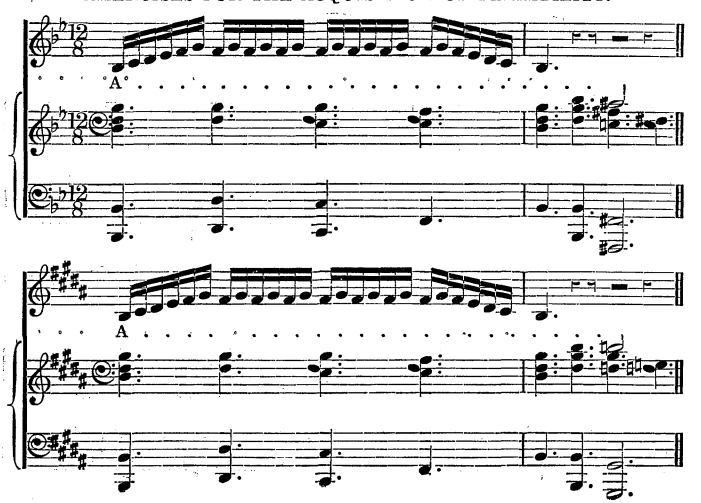
EXERCISES ON METHODS OF ATTACKING NOTES.

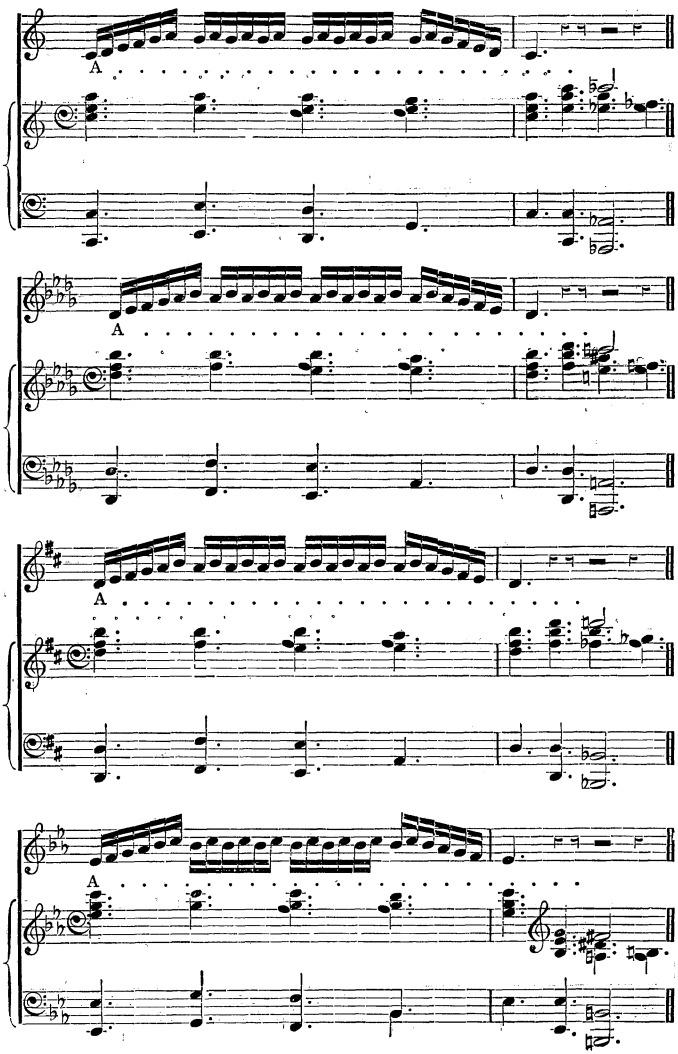




XVI.

EXERCISES FOR THE ACQUISITION OF FLEXIBILITY.

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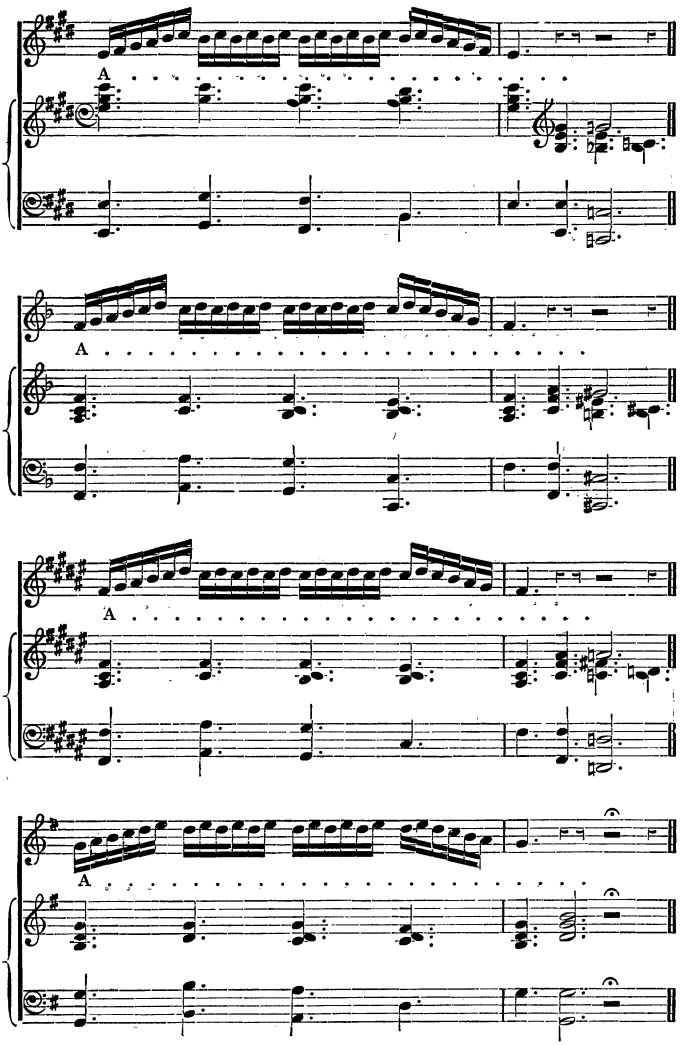
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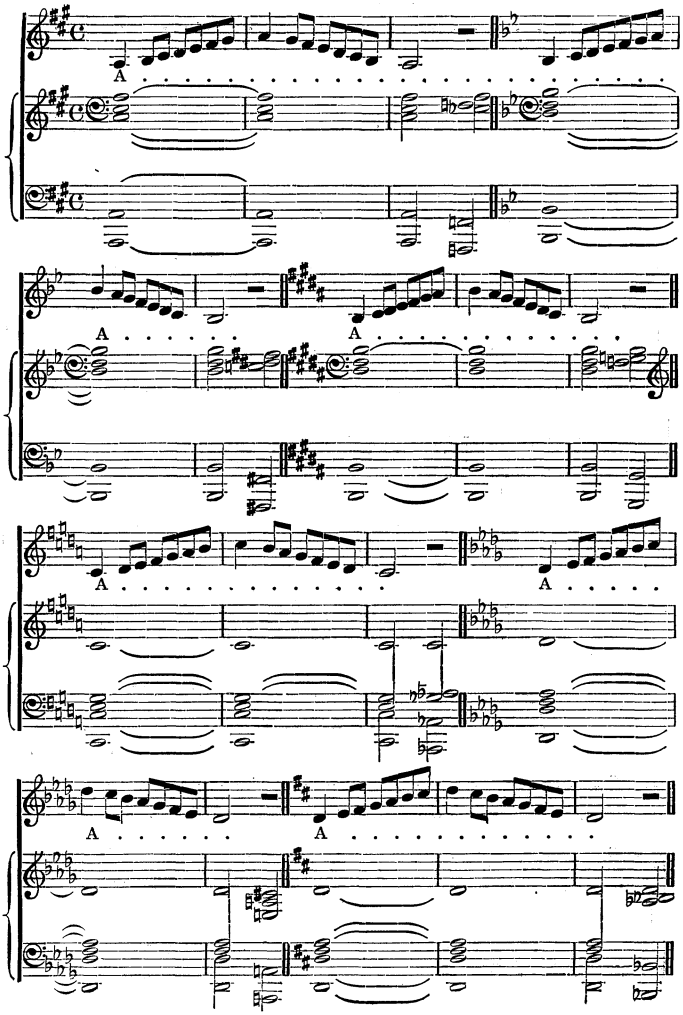
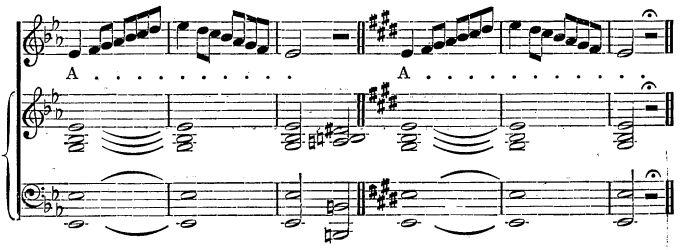
XVII.

SCALE EXERCISES.





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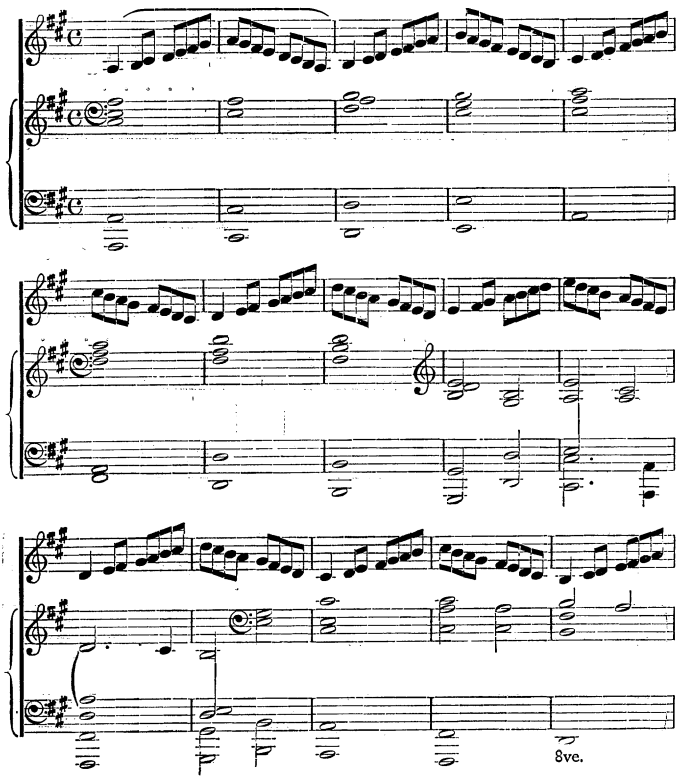
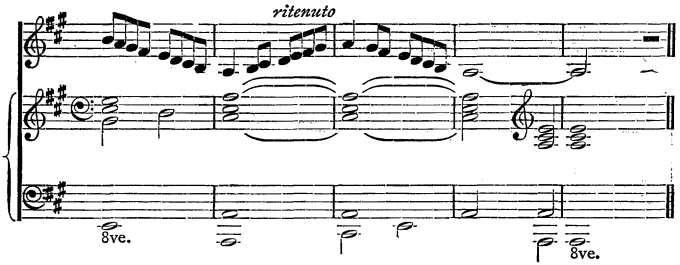
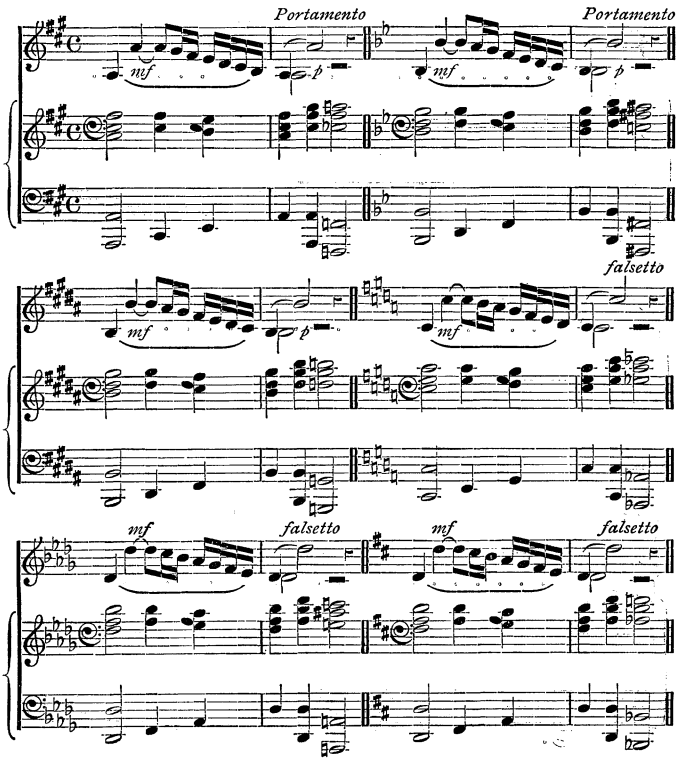
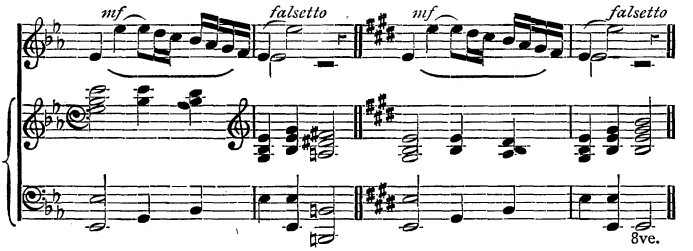




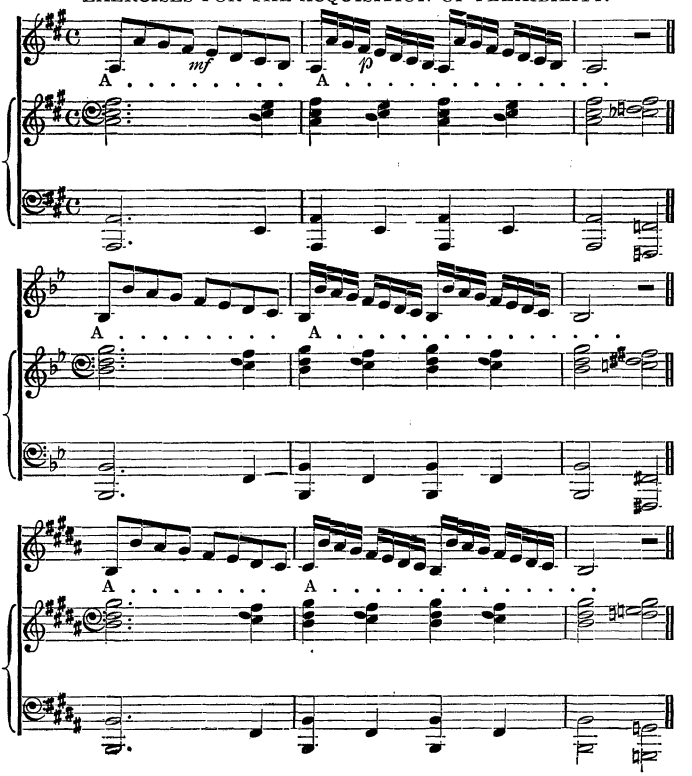
XIX.—PORTAMENTO EXERCISES.

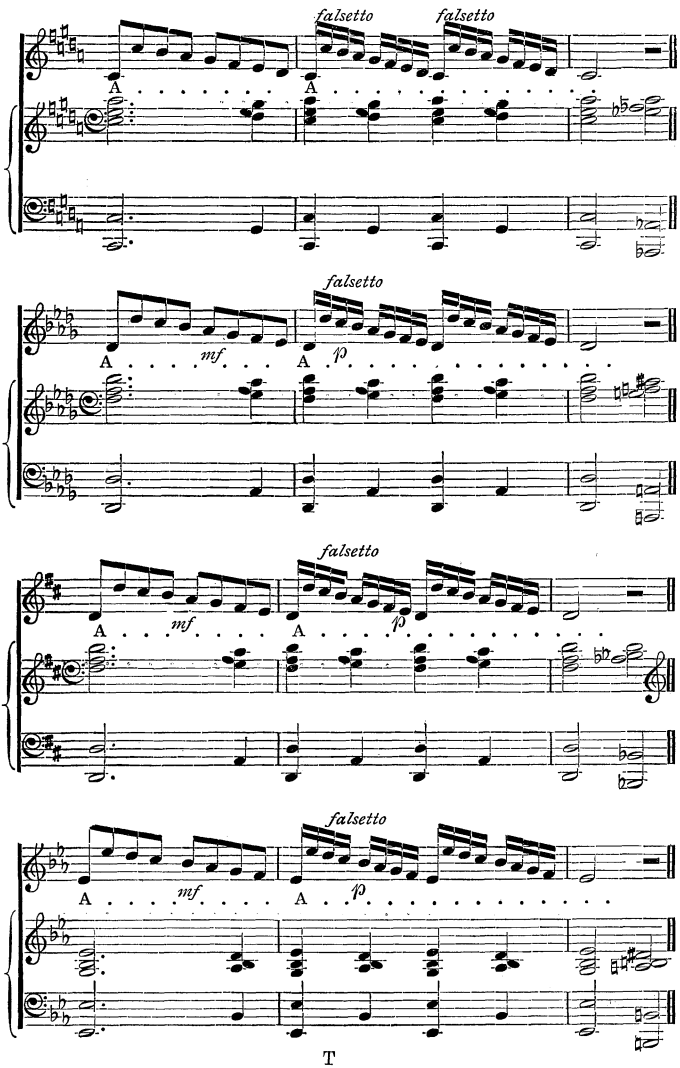




XX.

EXERCISES FOR THE ACQUISITION OF FLEXIBILITY.

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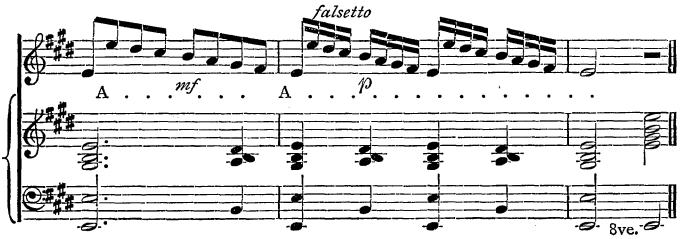
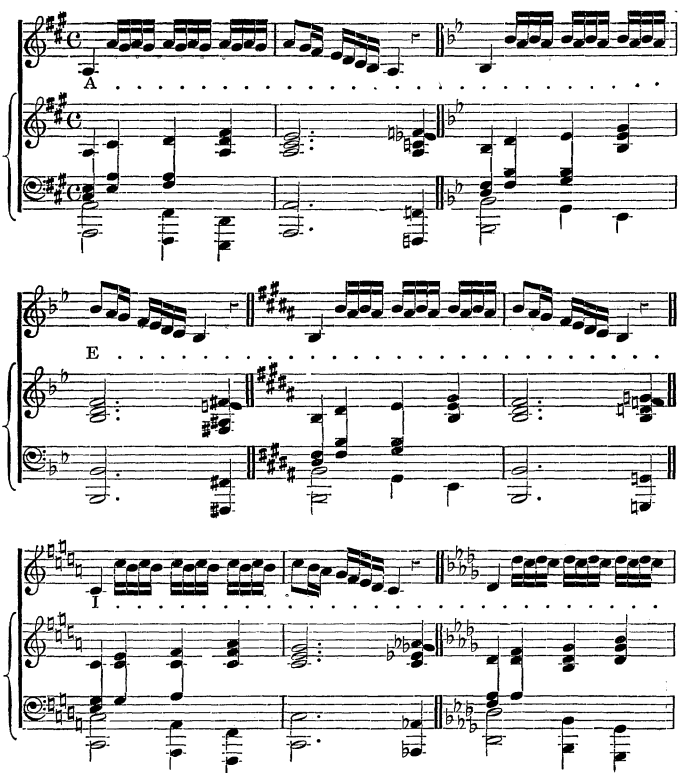
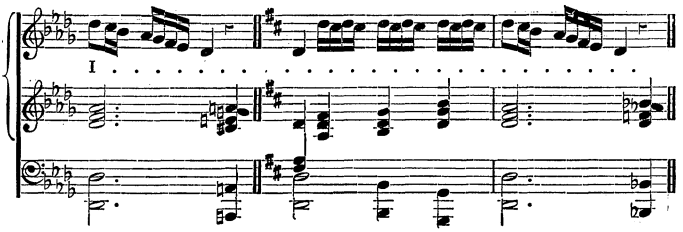
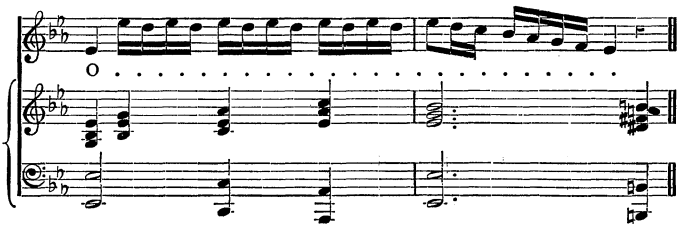
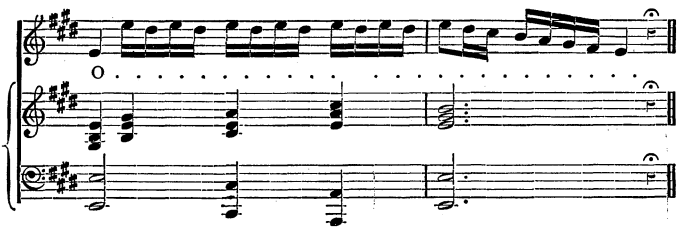


XXI.









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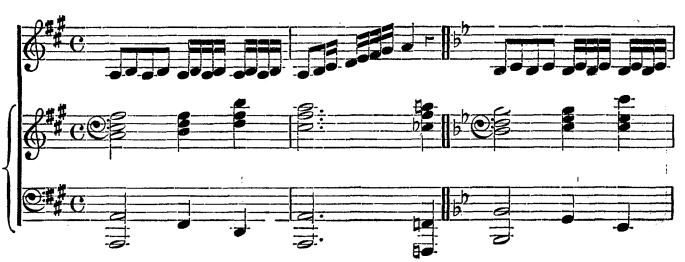
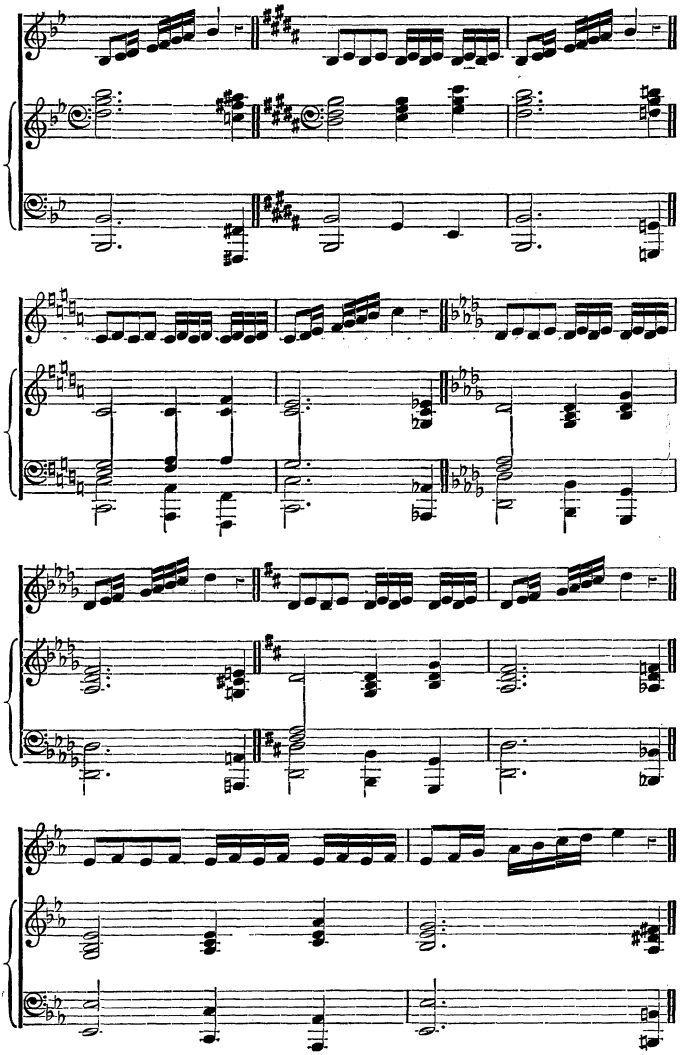
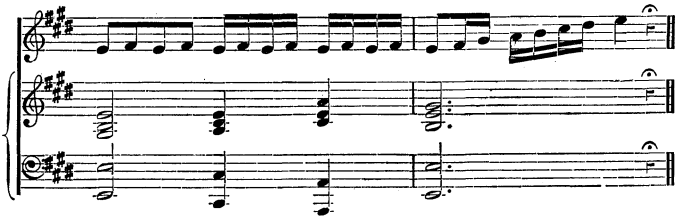


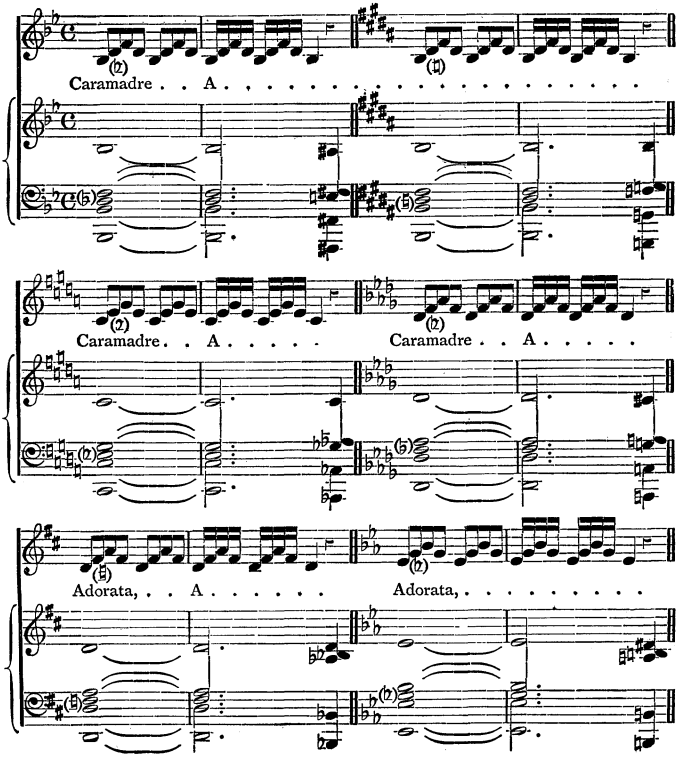


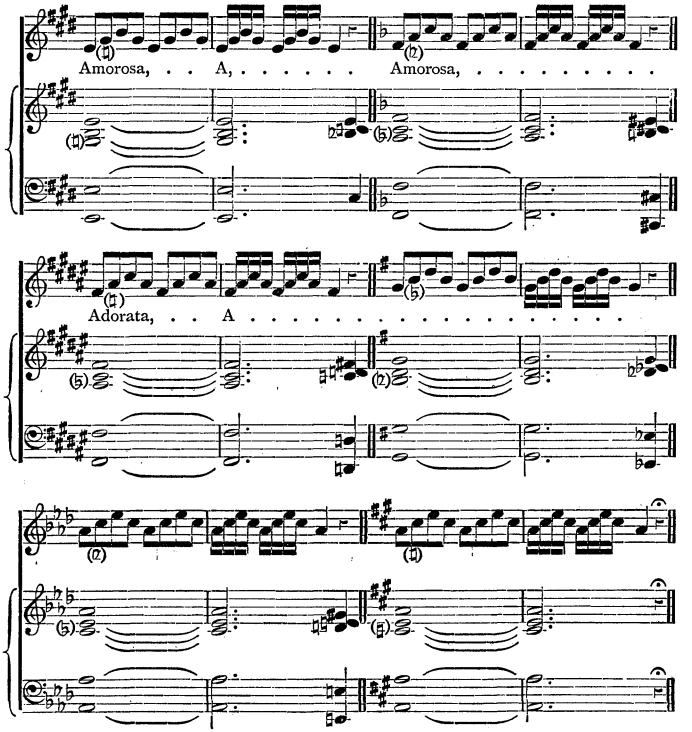


XXIII.

EXERCISES FOR THE TRAINING OF THE EAR.

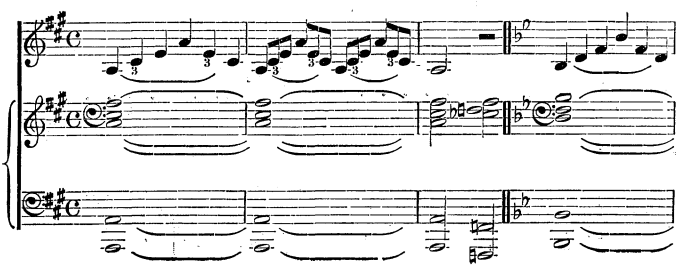
To be sung in the major and minor keys.

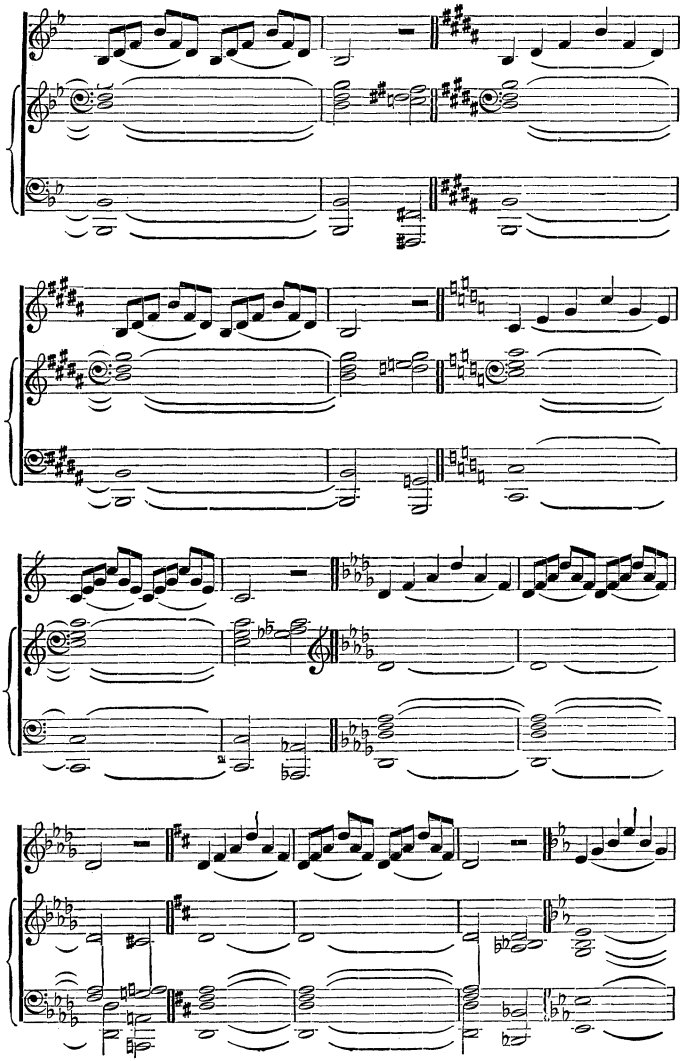


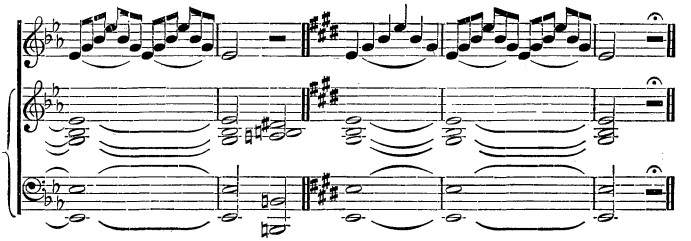


XXIV.

ARPEGGIOS.







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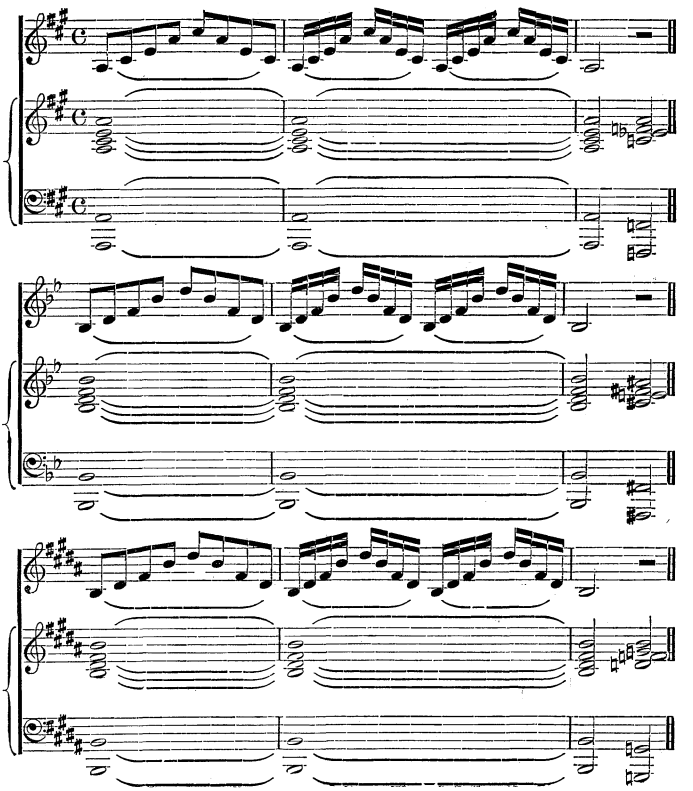
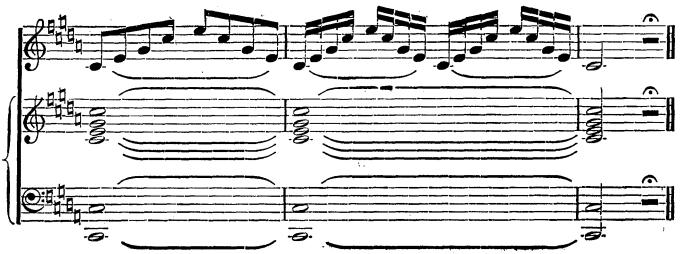
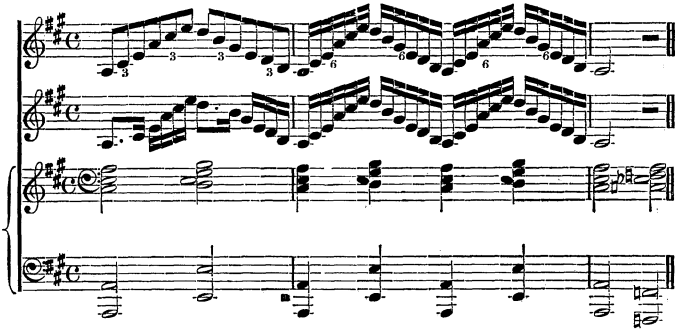
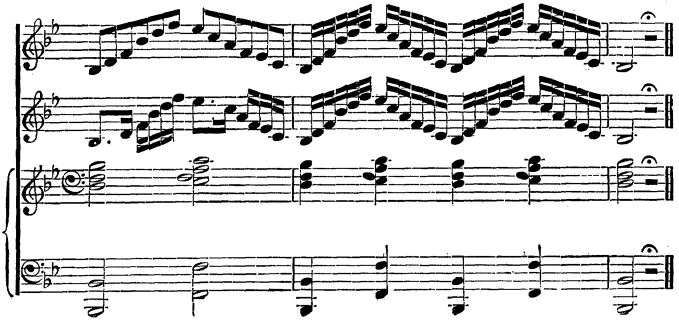




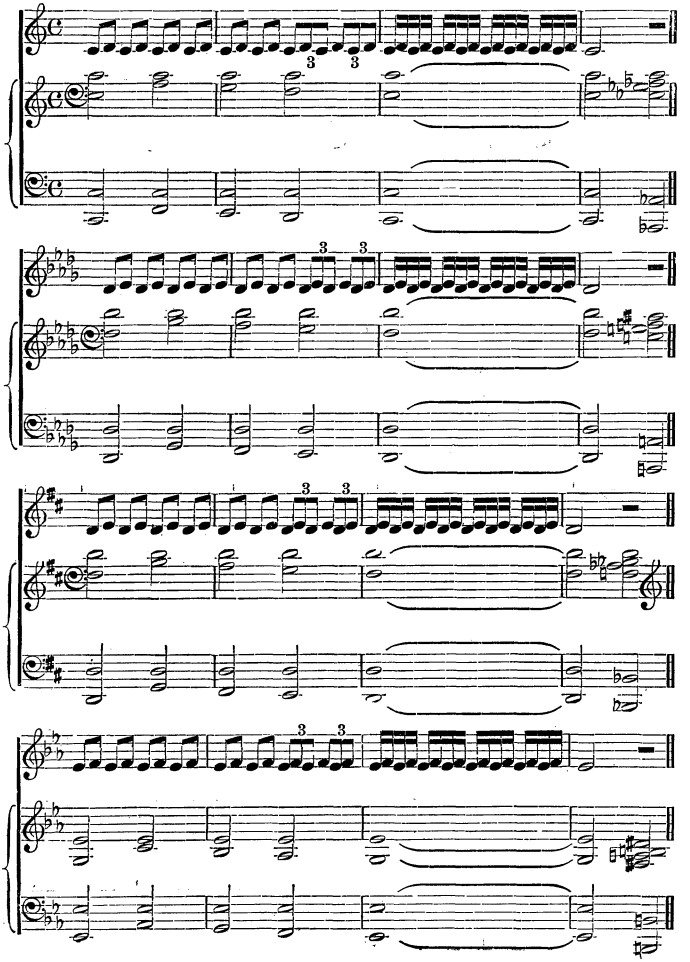
XXVI.

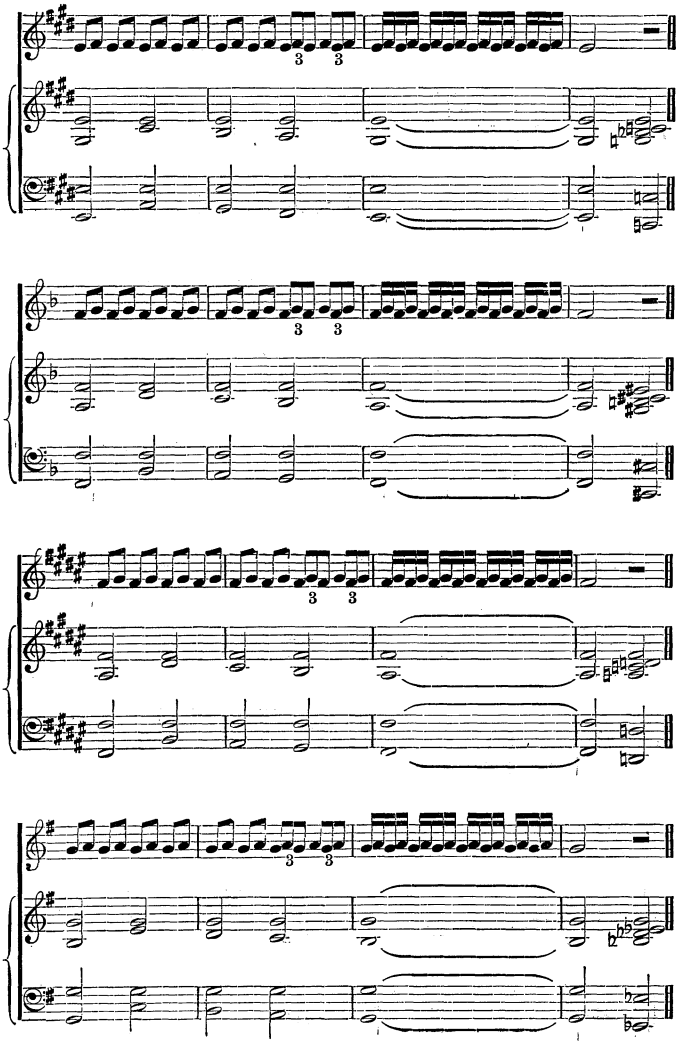


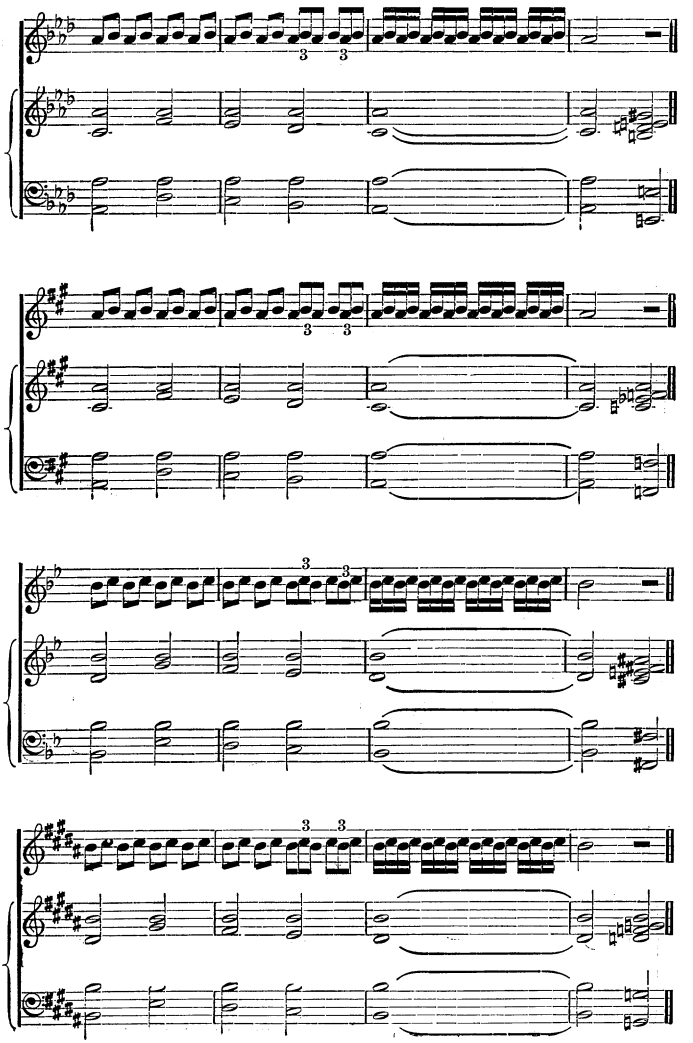


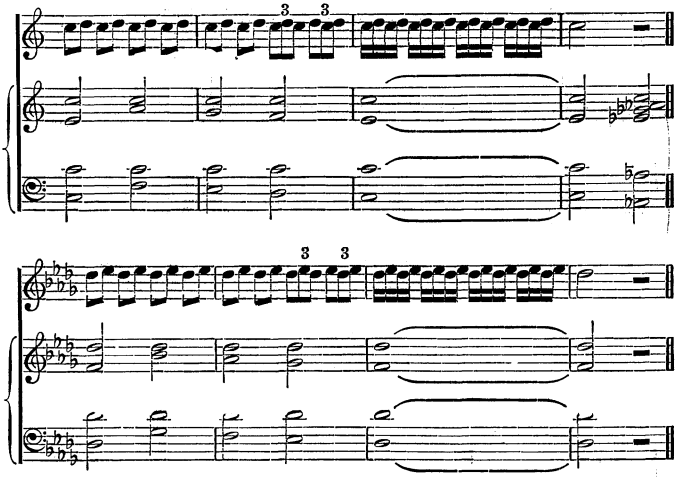
XXVII.—EXERCISES ON SHAKES.

In practising shakes, neither the lower jaw, nor the tongue, nor the lips must be allowed to move, and only the larynx is to rise and fall a little. At first the exercises must be sung *piano* and in moderate time, clearness of tone and purity of intonation being carefully attended to. Later on, *mezzo-forte* may be practised and the time accelerated.



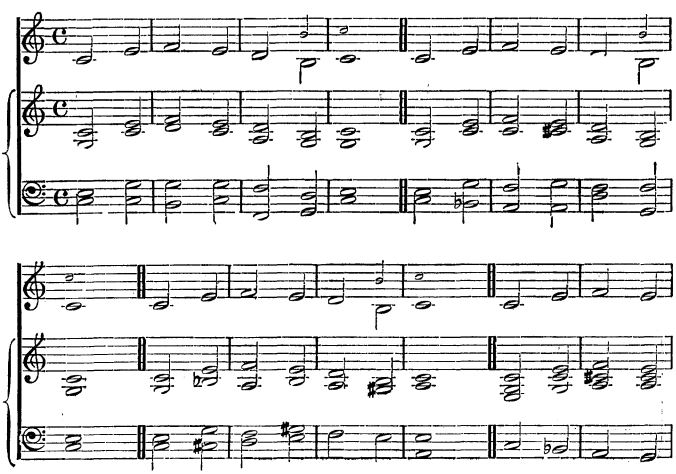


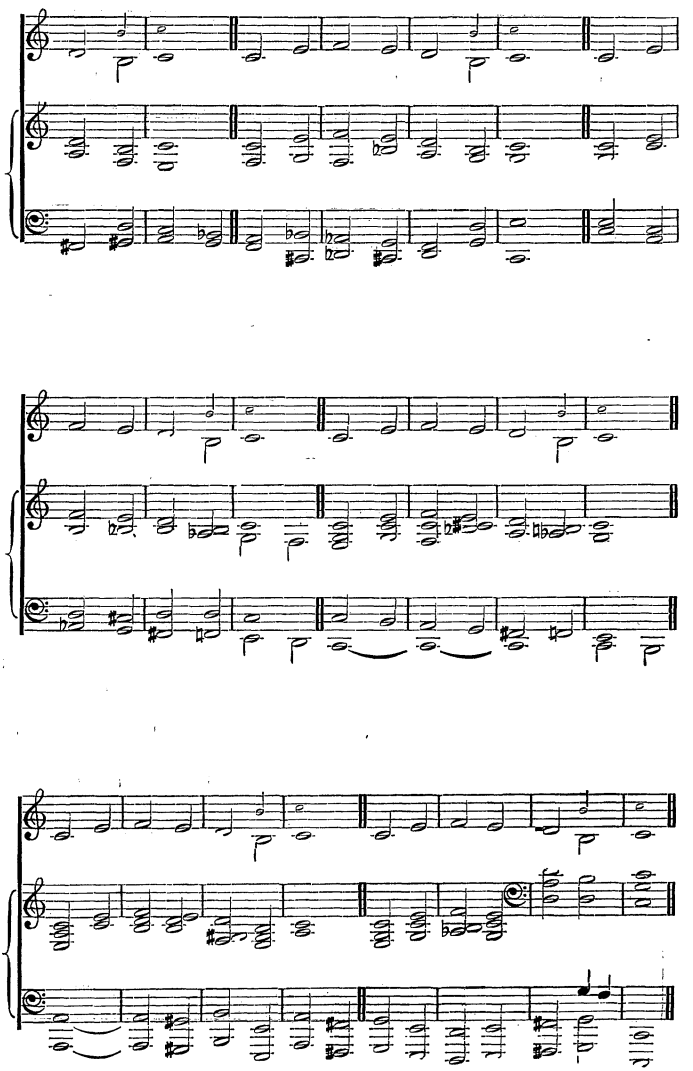




XXVIII.

INTONATION EXERCISES FOR THE TRAINING OF THE EAR.



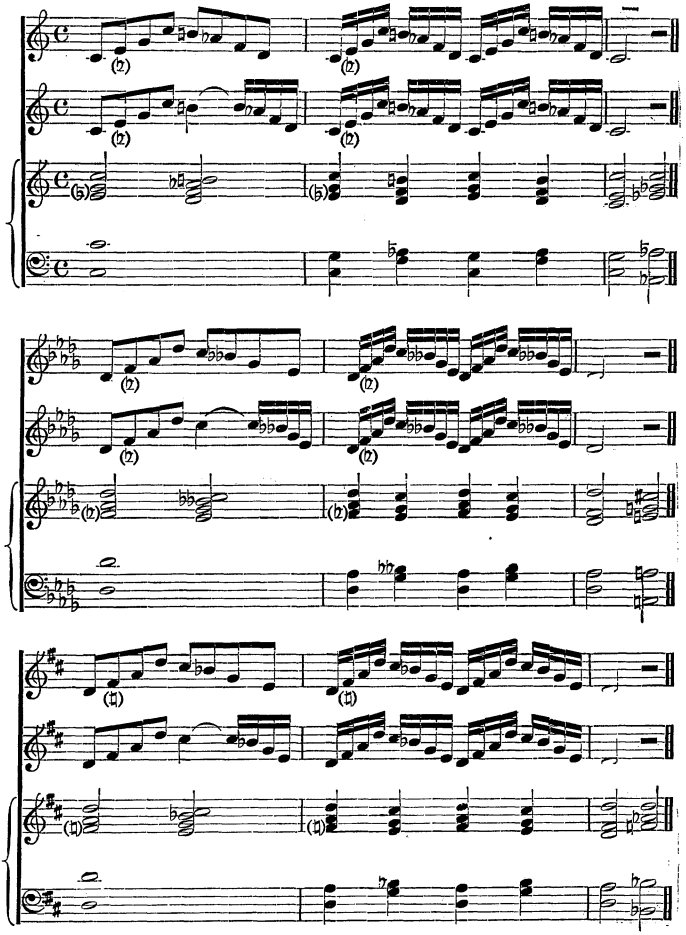


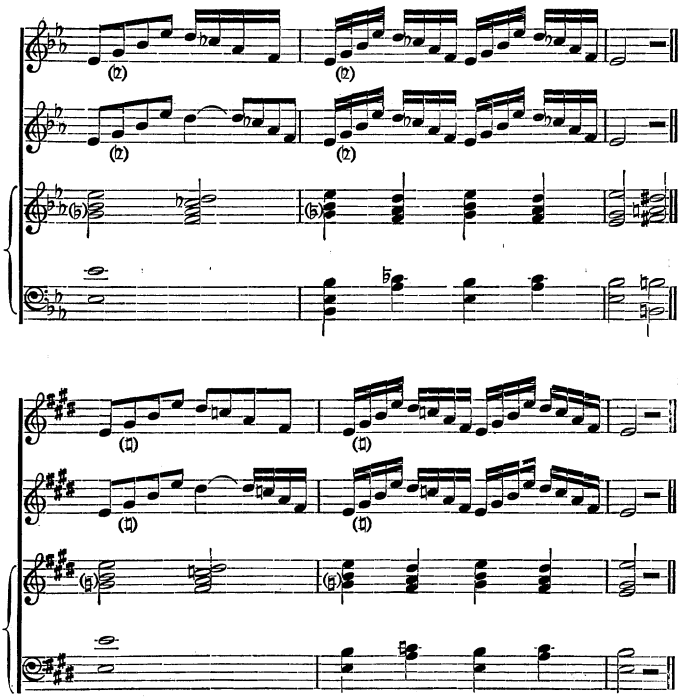
XXIX.

ARPEGGIOS.

INTONATION EXERCISES FOR THE TRAINING OF THR EAR.

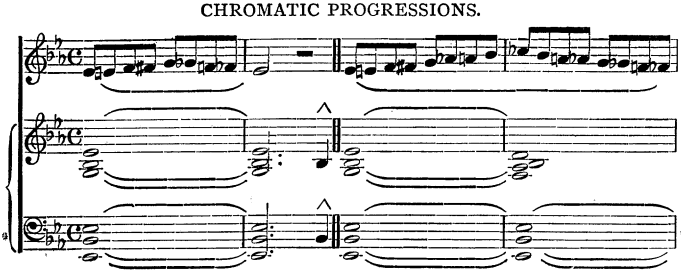
To be sung in the major and minor keys.

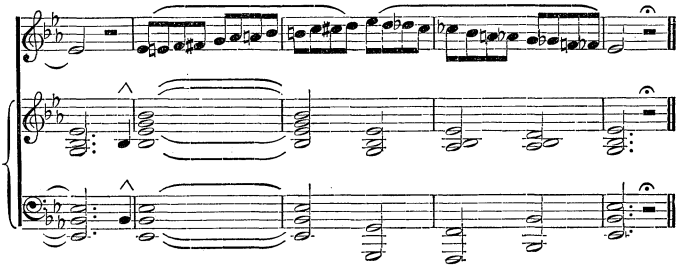




XXX.

CHROMATIC PROGRESSIONS.





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Philipp Spitta, Berlin.

In a letter, 10th October 1893, Professor Spitta writes to the author: "The reading of your book, 'The Art Ballad,' and in particular the ana-

lysis on p. 113 and the following pages, has given me sincere pleasure. There is no more danger that Loewe's ballads will be neglected: for a short time his compositions have fallen into oblivion, but now everywhere a lively interest for his works is observable, and in this popularisation you take a prominent part."

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"Mr Albert B. Bach, who gave a Loewe Recital last week, is a Hungarian, and studied at the Vienna Conservatoire, where for two years he was a pupil of Marchesi. After that he went to Italy, and put himself under the direction of Lamperti, Varesi, and Ronconi, and, having finished his studies, he toured through Italy and Germany. Later on, he was engaged at La Scala for two seasons—1877 and 1878—and in 1879 he sang at the Court Opera at Buda Pesth, where he was re-engaged in 1885. Among his favourite parts may be mentioned Mephisto in Gounod's 'Faust,' the King in Wagner's 'Lohengrin,' the Cardinal in 'La Juive,' and Mozart's 'Don Giovanni.' Since 1886, however, Mr Bach has only sung at concerts and oratorios. Much of the time he can spare from teaching is devoted to editing editions of songs, especially Schubert and Loewe, and to writing books on his art, among which may be mentioned 'The Principles of Singing,' 'On Musical Education and Vocal Culture,' and 'The Art Ballad: Loewe and Schubert' (Blackwood). Mr Bach, who for several years has been a successful professor of singing at Edinburgh, where he now lives, has had the honour of appearing before the Queen at Balmoral; and since last year he has been a naturalised Englishman."

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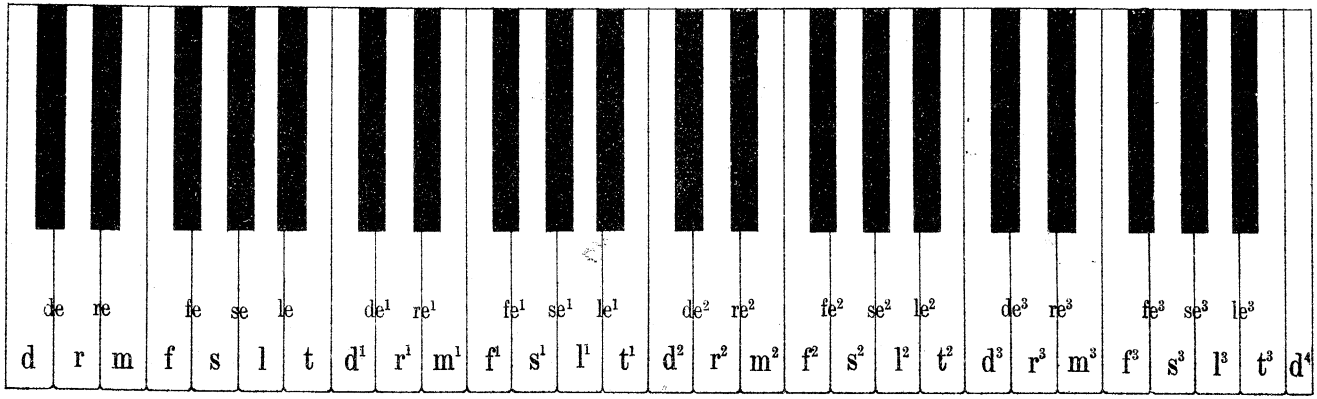
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